OHIO DEPARTMENT OF TRANSPORTATION
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July 15, 2011

To: Users of the Bridge Design Manual

From: Tim Keller, Administrator, Office of Structural Engineering

By: Sean Meddles, Bridge Standards Engineer

Re: 2011 Third Quarter Revisions

Revisions have been made to the ODOT Bridge Design Manual, January 2004. These revisions shall be implemented on all Department projects with a Stage 1 plan submission date after July 15, 2011.

This package contains the revised pages. The revised pages have been designed to replace the corresponding pages in the book and are numbered accordingly. Revisions, additions, and deletions are marked in the revised pages by the use of one vertical line in the right margin. The header of the revised pages is dated accordingly.

To keep your Manual correct and up-to-date, please replace the appropriate pages in the book with the pages in this package.

To ensure proper printing, make sure your printer is set to print in the 2-sided mode.

The January 2004 edition of the Bridge Design Manual may be downloaded at no cost using the following link:

http://www.dot.state.oh.us/Divisions/Engineering/Structures/standard/Pages/default.aspx

Attached is a brief description of each revision.

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Summary of Revisions to the January 2004 ODOT BDM

BDM Section	Affected Pages	Revision Description
203.2.H	2-19	An overly restrictive provision for a maximum one foot rise in backwater for bridges located outside of NFIP jurisdictions was removed.
204.6	2-24	The "Prestressed Concrete" wall type was replaced by "Precast Concrete"
209.3	2-38 through 2-39	The provisions for drainage flumes for surface drainage at the end of bridges were revised in accordance with Standard Hydraulic Construction Drawing DM-4.1.
304	3-82 through 3-87.2	• Introduce the AASHTO "Manual for Assessing Safety Hardware" (MASH). • Replace the use of the ODOT Design Data Sheet entitled "Railing Selection Procedure" with the AASHTO "Guide "Specifications for Bridge Railing", 1989. • The new Deep Beam Bridge Retrofit Railing, DBR-3-11, has been added to the list of standard railing types. • Require upgrading DBR-2-73 railing using DBR-3-11 on projects requiring TL-3 railings. • BDM Section 304.4.7 has been added to address the new Deep Beam Bridge Retrofit Railing, DBR-3-11.
606.4	6-20	The contact information for the H-pile splicer has been revised.
900	9-1 through 9-39	• It has been explicitly stated that the provisions of Section 900 may also be used on non-ODOT structures. • Stone masonry structures have been removed from the exemption list. • The pedestrian load application has been clarified. • The variable representing pedestrian load has been made consistent with the AASHTO LRFD specifications. • A new sub-section on the load analysis by LARS has been added. • The load factor for pedestrian load has been revised to 1.0. • A new sub-section on the load rating of non-ODOT bridges has been added. • The requirements for bridge load rating on design-build projects have been modified.

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allowable backwater elevation corresponds with the backwater elevation which currently exists.

G. When a proposed structure is subject to the approval of a Conservancy District, the waterway shall be designed to comply with their regulations if more restrictive than ODOT's.

H. The design of all highway encroachments on the 100 year flood plain shall comply with the regulations as stated in the Code of Federal Regulations (23 CFR 650 A). Engineers responsible for bridge hydraulics should read these regulations to become familiar with their contents. When a highway encroachment is located in a detailed NFIP study area, create a duplicate of the original NFIP water surface model. Actual field survey data may be used to supplement the original NFIP data.

When making an encroachment, the proposed structure size submitted for preliminary design review shall be supported by an analysis of design alternatives with consideration given to capital costs and risk. "Risk" is defined as the consequences attributable to an encroachment. Risk includes the potential for property loss and hazard to life (A Flood Hazard Evaluation).

When making an encroachment on a NFIP designated flood plain in the floodway fringe, the rise in the water surface is limited to one foot [0.3meters] above the natural 100 year flood elevation as given by the NFIP study. No increase in the 100 year water surface is allowed when encroaching on a NFIP designated floodway (44 CFR 60.3(d)(3)). See Figure 201.

For bridges located outside NFIP jurisdiction regions, the responsible government agency which initiated the project will be responsible for contacting and coordinating with the Local Flood Plain Coordinator.

Longitudinal encroachments require alternative location studies to be summarized in the Conceptual Alternatives Study (L&D Section 1403.3). Evaluation of specific bridge hydraulics may not be necessary when alternative highway alignments are under consideration for the project. Refer to the Code of Federal Regulations (23 CFR 650 A) for more specific information.

I. It should not be assumed that an attempt should be made to lower existing high water elevations. However, for bridge replacement projects where the existing structure is severely hydraulically taxed, an effort should be made to improve the hydraulics for both the design and 100 year recurrence interval discharges, with consideration of the one foot [0.3 meters] rise criterion discussed in Section 203.2.h. No allowable backwater requirements are set by these criteria; rather the allowable backwater should be determined by good engineering judgment considering the area inundated and the mean velocities induced through the structure.

J. In general, the bridge should be designed to clear the design year frequency flood. This criterion may be waived because of roadway design constraints such as existing at-grade intersections, perpetuating existing profile grades, existing backwater elevations, presence of existing road overflow or other reasons.

to support the abutment should consider possible settlement of the MSE wall. Use piles to support the abutment if the bridge is a continuous multi-span structure, or if the bridge is constructed part width in phases. If the bridge is a single-span structure and is not constructed part width in phases, then either spread footings or piles may be used to support the abutment. Piles require a minimum 15-foot embedment below the MSE wall.

Refer to Sections 201.2.6, 202.2.3 and 204.6.2 for the staged review requirements for MSE walls. Consult the Office of Structural Engineering for additional design recommendations.

204.5 PIER TYPES

For highway grade separations, the pier type should generally be cap-and-column piers supported on a minimum of 3 columns. (This requirement may be waived for temporary conditions that require caps supported on less than 3 columns.) Typically the pier cap ends should be cantilevered and have squared ends.

For bridges over railroads generally the pier type should be T-type, wall type or cap and column piers. Preference should be given to T-type piers. Where a cap and column pier is located within 25 feet [7.6 meters] from the centerline of tracks, crash walls will be required.

For waterway bridges the following pier type should be used:

A. Capped pile type piers; generally limited to a maximum height of 20 feet [6 meters]. For heights greater than 15 feet [4.5 meters], the designer should analyze the piles as columns above ground. Scour depths shall be considered.

B. Cap-and-column type piers.

C. Solid wall or T-type piers.

Note that the use of T-type piers, or other pier types with large overhangs, makes the removal of debris at the pier face difficult to perform from the bridge deck. For low stream crossings with debris flow problems and where access to the piers from the stream is limited, T-type piers, or other similar pier types, should not be used.

For unusual conditions, other types may be acceptable. In the design of piers which are readily visible to the public, appearance should be given consideration if it does not add appreciably to the cost of the pier.

204.6 RETAINING WALLS

In conformance with Section 1400 of the ODOT Location and Design Manual, Volume Three, a Retaining Wall Justification shall be included in the Preferred Alternative Verification Review Submission for a Major Project or in the Minor Project Preliminary Engineering Study Review Submission. A description of the Retaining Wall Justification is provided in Section 1404 of the ODOT Location and Design Manual, Volume Three. Generally, the justification compares the practicality, constructability and economics of the various types of retailing walls listed below:

A. Cast-in-place reinforced concrete
B. Precast concrete
C. Tied-back
D. Adjacent drilled shafts
E. Sheet piling
F. H-piling with lagging
G. Cellular (Block, Bin or Crib)
H. Soil nail
I. Mechanically Stabilized Earth (MSE)

Refer to SS840 for accredited MSE wall systems. Contact the Office of Structural Engineering for modular block wall systems. For wall systems that utilize geogrid reinforcements, the wall height shall be limited to 30 ft.

204.6.1 DESIGN CONSTRAINTS

Below are some design constraints to consider inthe wall justification study to establish acceptable wall types:

A. Future use of the site (future excavations cannot be made in Mechanically Stabilized Embankments)
B. Deflection and/or differential settlements
C. Accessibility to the construction site
D. Aesthetics, including wall textures
E. Right-of-way (or other physical constraints)
F. Cost (approximate cost analysis)
G. Stage construction
H. Stability (long-term and during construction)
I. Railroad policies

204.6.2 STAGE 1 DETAIL DESIGN SUBMISSION FOR RETAINING WALLS

When a justification study has determined that a retaining wall is required, generally the wall will be a cast-in-place reinforced concrete wall or some type of proprietary wall system. The use of proprietary wall systems should be considered when the wall quantity for the project exceeds 5000 ft^2 [450 m^2].

209 MISCELLANEOUS

209.1 TRANSVERSE DECK SECTION WITH SUPERELEVATION

If the change in cross slope at the superelevation break point is less than or equal to 7 percent, then no rounding is required. For changes greater than 7 percent the bridge deck surface profile shall be as follows:

A. When the roadway break point is located between roadway lanes (not at the edge of pavement) the bridge cross slope is to extend to the toe of parapet. See "CASE a" in Figure 204.

B. When the roadway break point is located at the edge of pavement (adjacent shoulder width is less than four feet [1.2 meters]), the bridge cross slope is to be continued past the break point to the toe of deflector parapet. See "CASE b" in Figure 204.

C. When the roadway break point is located at the edge of pavement (adjacent shoulder width is equal to or greater than four feet [1.2 meters] and less than eight feet [2.4 meters]), a four foot [1.2 meter] rounding distance from the edge of pavement onto the shoulder is used to transition from the bridge cross slope to the ½ inch per foot [0.04] shoulder cross slope. See "CASE c" in Figure 205.

D. When the roadway break point is located at the edge of pavement (adjacent shoulder width is equal to or greater than eight feet [2.4 meters]), a five foot [1.5 meter] rounding distance from the edge of pavement onto the shoulder is used to transition from the bridge cross slope to the ½ inch per foot [0.04] shoulder cross slope. See "CASE d" in Figure 205.

The transition from the roadway approach transverse section to the bridge deck transverse section is to take place within the limits of the approach slab, whenever possible. On bridges with high skews, it may not be possible to do the transition within these limits and other alternatives should be considered during the Assessment of Feasible Alternatives.

For decks with over the side drainage, the treatment of the deck and the shoulder slopes shall be as described in subsections a through d above except that the slope shall continue to the edge of the deck.

209.1.1 SUPERELEVATION TRANSITIONS

Because of the complexities associated with superelevation transitions on bridge superstructures (i.e. beam and girder cambering, crossframe fabrication, deck form construction, slip forming of parapets, etc.) all reasonable attempts should be made to keep such transitions off of bridge decks. Where transitions must be located on bridge decks, preferably, the transitions should be straight. An example of a transition diagram is shown in Figure 206. A table with the information shown in Figure 206 is also acceptable. Where this is not practicable, then transition's discontinuities should be smoothed by inserting 50 foot [15 meter] roundings at each discontinuity.

209.2 BRIDGE RAILINGS

All bridge structures on the National Highway System (NHS) or the State System require the use of crash tested railing meeting the loading requirements of TL-3 as defined by NCHRP report 350. The requirement for the NHS became effective October 1, 1998. For detailed information, refer to Section 304.

For structures with over the side drainage on the National Highway System, Twin Steel Tube Bridge Guardrail, Standard Bridge Drawing TST-1-99 should be used.

Over the side drainage shall not be used for bridges over highways and railroads. For four lane divided highways concrete deflector parapets shall be used. For bridges with heights of 25 feet [7.6 meters] or more above the lowest groundline or normal water, concrete deflector parapets should be used.

Refer to Section 305 of this Manual for vandal protection fencing requirements.

209.3 BRIDGE DECK DRAINAGE

The preferred minimum longitudinal grade of the bridge deck surface, when using concrete parapets, is 0.3 %, whenever possible.

The number of scuppers used for collecting the deck surface drainage should be minimized or eliminated if possible. The allowable spread of flow, which is used to help determine the need for scuppers, can be computed by the procedures as described in Section 1103 of the ODOT Location and Design Manual. Scuppers when provided, should preferably be located inside the fascia beam.

Drainage collection systems should be sloped as steeply as practical, generally not less than 15 degrees. The system should have a minimum bend radius of 18 inches [450 mm], no 90 degree bends, adequate pipe supports and cleanouts at the low ends of runs. The cleanout plugs should be easily and safely accessible. The necessary deck drainage outlet locations should be included in the Structure Type Study, Hydraulics Report.

Scuppers with drainage collection systems should be placed as closely as possible to the substructure unit which drains them. Uncollected scupper downspouts should be as far away from any part of the structure as possible.

When the deck drainage is to flow off the ends of the bridge, provisions must be made to collect and carry away this run-off. On bridges without MSE walls at the abutments and where the pavement flow from the deck is no more than 0.75 ft^3/s [0.021 m^3/s], a flume, as shown on Standard Construction Drawing DM-4.1, should be provided. On grade separation structures with 2:1

approach embankment slopes and where the pavement flow from the deck exceeds 0.75 ft^3/s [0.021 m^3/s], an integral curb shall be provided on the approach slab with a standard catch basin located off the approach slab in lieu of the flume. At the trailing end of bridge barriers, a bridge terminal assembly is required to protect this curb. The catch basin should be a Catch Basin No. 3A, as shown on Standard Construction Drawing CB-2.2. A properly sized conduit (Type F, 707.05 Type C) shall be used to provide an outlet down the embankment slope and the outlet shall be armored to prevent erosion.

Control of drainage is especially critical at abutments with MSE walls. On structures with MSE walls at the abutments, a barrier shall be provided on the approach slab with a standard catch basin to collect the drainage. Where possible, the catch basin shall be located at least 25 ft [7.6 m] beyond the limits of the MSE wall soil reinforcement. Continue the barrier 10 ft [3.0 m] past the catch basin. Use the same type of catch basin and conduit as described above.

For bridges that have deck joints consisting of finger joints or sliding plates with a trough collector system scuppers should be considered near the joint to minimize the amount of deck drainage flow across the joint.

For bridges that have over the side drainage a stainless steel drip strip should be provided to protect the deck edge and beam fascia from the deck surface run-off.

209.4 SLOPE PROTECTION

For structures of the spill-thru type where pedestrian traffic adjacent to the toe of the slope is anticipated or the structure is located in an urban area within an incorporated city limit, the slope under the structure shall be paved with Concrete slope protection, CMS 601.07. Consideration of slope protection should be given to all areas under freeway bridges over city streets not covered by pavement or sidewalk. Drainage discharge from the bridge should be checked to ensure that discharge is not crossing sidewalks, etc. so that ice, dirt and debris build-ups are prevented.

On spill-thru slopes under grade separation structures, areas that are not protected by concrete slope protection, shall be protected by crushed aggregate material as provided in CMS 601.06.

The slope protection, either concrete or rock, shall extend from the face of the abutment down to the toe of the slope and shall extend in width to 3 feet [1 meter] beyond the outer edges of the superstructure, except that at the acute corners of a skewed bridge the outside edge of the slope protection shall intersect the actual or projected face of the abutment 3 feet [1 meter] beyond the outer edge of the superstructure and shall extend down the slope, normal to the face of the abutment, to the toe of the slope. The base of the slope protection shall be toed in. Note that the natural vegetation on the slopes when shaded by a new structure will die out. For this case additional slope protection should be considered.

209.5 APPROACH SLABS

Approach slabs should be used for all ODOT bridges. Determine the length of the approach slab using the following formula:

$L = [1.5(H + h + 1.5)] \div \cos\theta \leq 30$ ft
$L = [1.5(H + h + 0.45)] \div \cos\theta \leq 9.15$ m

Where:
- L = Length of the approach slab measured along the centerline of the roadway rounded up to the nearest 5 ft [1.5 m]
- H = Height of the embankment measured from the bottom of the footing to the bottom of the approach slab (ft) [m]
- h = Width of the footing heel (ft) [m]
- θ = Skew angle

For four lane divided highways on new embankment, the minimum approach slab length shall be 25 ft [7.6 m] (measured along the roadway centerline). For structures with MSE walls at the abutments, the minimum approach slab length shall be 30 ft [9.1 m]. For all other structures the minimum length shall be 15 ft [4.6 m]. Refer to the approach slab standard bridge drawing for details.

Provide detail drawings for approach slabs which differ from the standard approach slabs. Examples include approach slabs that are a non-standard length, tapered, have a non-uniform width, or other such variation. When an approach slab falls within the limits of a vertical curve or superelevated section, the elevations at the edges of the approach slab shall be provided. Include these detail drawings in the structure plans for review during the detail design review stage. Approach slabs are paid for under Item 526.

On structure rehabilitation plans, when the existing approach slab is to be removed, the Designer shall include Item 202 - Approach Slab Removed in the structures estimated quantities.

209.6 PRESSURE RELIEF JOINTS

Type A pressure relief joints shall be specified when the approach roadway pavement is rigid concrete and shall be placed at the end of the approach slab.

The pressure relief joints are detailed on Standard Construction Drawing BP-2.3 (Revised 7/28/00), “Pressure Relief Joint Type A”.

209.7 AESTHETICS

Each structure should be evaluated for aesthetics. Normally it is not practical to provide cost premium aesthetic treatments without a specific demand, however careful attention to the details of the structure lines and forms will generally result in a pleasing structure appearance.

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304 RAILING

304.1 GENERAL

All railing on bridges with the type of “Proposed Work” listed below, shall meet acceptance criteria contained in NCHRP Report 350 or AASHTO “Manual for Assessing Safety Hardware” (MASH). The minimum acceptance level shall be TL-3 unless supported by the AASHTO “Guide Specifications for Bridge Railing”, 1989.

“Proposed Work” that requires NCHRP Report 350 or MASH compliance includes:

A. New construction on all routes.
B. Complete deck replacements on all routes.
C. Replacement of deteriorated deck edges on all routes.
D. Superstructure widenings on all routes.
E. Rigid concrete overlays on NHS routes.
F. Rigid concrete overlays on non-NHS routes with design speeds of 40 mph or greater.

For other types of “Proposed Work”, including roadway railing upgrade projects, NCHRP Report 350 or MASH compliance of the bridge railing is not warranted, but a positive connection between the approach railing and the existing bridge railing is required.

Bridge railings that have been found acceptable under the crash testing acceptance criteria defined in NCHRP Report 230 and the AASHTO Guide Specification for Bridge Railing, 1989 including all interims, will be considered as meeting the requirements of NCHRP Report 350 without further testing as indicated in the following table.

Bridge Railing Testing Criteria	Acceptance Equivalencies					
NCHRP 350	TL-1	TL-2	TL-3	TL-4	TL-5	TL-6
NCHRP 230		MSL-1 MSL-2		MSL-3		
AASHTO Guide Specification		PL-1	PL-2		PL-3	

Section 301.1 of this Manual lists standard ODOT bridge railing types available along with the corresponding NCHRP Report 350 level of acceptability. For non-standard railing designs, a review submission, concurrent with the Structure Type Study, shall be made to the Office of Structural Engineering as stated in Section 201 of this Manual. The design of all non-standard railing systems shall be based on the NCHRP Report 350 or MASH level of acceptability. Designers may be required to submit actual crash test report data to verify the level of acceptability of a proposed design.

Modifications to the ODOT standard railing types or other NCHRP 350 or MASH approved railing system should be avoided. Additional structural steel tubing added to satisfy pedestrian concerns does not require additional crash testing provided these elements do not protrude nearer to the roadway than the rail elements on the tested design and they do not present any type of snagging potential to an impacting vehicle. If an accepted crash tested railing system is modified, the face geometry (i.e. offset, rail height, spacing, etc.) shall match the tested design and the static strength and deflections shall remain at least equal to the tested design. Include with the preliminary design submission to the Office of Structural Engineering, strength and deflection calculations to support these modifications. The calculations shall follow the procedure defined in the AASHTO LRFD Bridge Design Specifications, 2nd Edition, Sections A13.1-3. The intent of any modification shall be to maintain the original NCHRP 350 or MASH acceptability level.

All railing elements fabricated with ASTM A500 steel tubing shall specify a drop-weight tear test per CMS 707.10. Provisions shall be made at tube splices for expansion and contraction. Steel railing systems shall also allow for structural movement at expansion joints without adversely affecting the system's level of acceptability.

Aesthetically pleasing railing systems have been successfully crash tested but are for use only where TL-2 acceptability requirements are allowed. These systems include the Texas Classic Traffic Railing, Type T411 with open windows, a smooth stone masonry barrier with reinforced concrete core wall and an artificial stone precast concrete barrier. Detailed information regarding the latter two systems may be found in FHWA Report No. FHWA-RD-90-087 "Guardrail Testing Program: Final Report", June 1990 and FHWA Report No. FHWA-SA-91-051 "Summary Report on Selected Aesthetic Bridge Rails and Guardrails", June 1992.

The recommended railing design for bridges with combination vehicular and pedestrian traffic is detailed in Standard Bridge Drawing BR-2-98. Other designs are allowed as previously mentioned above, provided the following requirements are met:

A. The curb height shall be 8".
B. The sidewalk width shall be 5'-0" or greater.

A pedestrian railing may be used in lieu of a crash tested barrier at the deck edge provided a crash tested barrier system meeting the minimum requirements for the specific location is used to separate the vehicular and pedestrian traffic. Pedestrian railing shall be designed in accordance with AASHTO.

304.2 STANDARD RAILING TYPES

Drawing No.	Description	NCHRP Level
BR-1	36" Deflector Parapet Type	TL-4
BR-1	42" Deflector Parapet Type	TL-5
BR-2-98	Bridge Sidewalk Railing with Concrete Parapet	TL-4
DBR-2-73	Deep Beam Bridge Guardrail	TL-2
DBR-3-11	Deep Beam Bridge Retrofit Railing	TL-3
PCB-91	Portable Concrete Barrier (Fully Anchored)	TL-4
	Portable Concrete Barrier (Unanchored)	TL-3
SBR-1-99	42" Single Slope Parapet Type	TL-5
TBR-91	Thrie Beam Bridge Railing (Retrofit)	TL-4
TST-1-99	Twin Steel Tube Bridge Railing	TL-4

304.3 WHEN TO USE

304.3.1 PARAPET TYPE (BR-1 & SBR-1-99)

The department currently has three (3) standard concrete parapet type bridge railing systems: a 36" New Jersey shape, a 42" New Jersey shape and a 42" single slope shape. These systems are for use on roadway and railroad overpass structures with no sidewalks and structures where the finished deck surface is 25 ft [7.62 m] or more above the ground line or water surface. Details for these parapet types, including end transitions to terminal assemblies, are provided in the Standard Bridge Drawings. The transition section may be placed on a structure's turned back wingwalls, widened approach slab or directly on the actual structure. If the transition section is placed directly on the structure, a curb is required for the full length of the approach slab.

The 36" barrier section is for use on structures located on two (2) lane routes with an ADTT in one direction less than 2500.

The 42" barrier sections are for use on structures located on interstates, divided highways of four (4) lanes or more, and two (2) lane routes with an ADTT in one direction of 2500 or more. Final decision of which section to use rests with the districts and should be finalized during the preliminary structural design review. The single slope barrier section is unaffected by the placement of future overlays, but weighs 23% more than the 42" New Jersey type parapet.

A 50" deflector type median barrier and a 57" single slope median barrier are for use on structures where protection against oncoming headlight glare is required. The structure's barrier height and type shall match the design of the adjoining roadway median barrier.

For each of the above listed barrier types, designers are required to confirm the structural adequacy of the concrete deck slab as described in the "Concrete Deck Design" Section 302.2 of this manual.

All concrete parapet type barriers shall be designed and detailed as follows:

A. All horizontal reinforcing steel shall be detailed as continuous for the total length of the structure.

B. Crack control joints shall be sawed into the concrete parapets. The distance between the saw-cut joints on the structure shall be between 6'-0" and 10'-0". The detailed locations of the crack control joints and vertical reinforcing bars shall be shown in the contract plans for all parapet types.

C. The saw-cut crack control joint shall be detailed as 1 ¼ inch deep and shall be filled with a polyurethane or polymeric material conforming to ASTM C920, Type S. The bottom one-half inch of both the inside and outside face shall be left unsealed to allow any water that enters the joint to escape. This requirement is established in the Standard Bridge Drawings; however, a plan note is required for special designs. See Section 600.

304.3.2 DEEP BEAM BRIDGE GUARDRAIL (DBR-2-73)

This railing configuration does not meet the Department's minimum NCHRP 350 or MASH acceptance criteria (i.e. TL-3) for use on any project described in Section 304.1 of this manual. In no case, shall this railing system be used on an overpass structure or a project where the finished deck surface is greater than 25 feet above the normal water surface elevation or final ground line.

When a structure is included in a project, as defined in Section 304.1 of this manual, existing Deep Beam Bridge railing shall be upgraded in accordance with Standard Bridge Drawing, DBR-3-11.

The standard configuration for this rail type does not meet the minimum requirements specified by AASHTO for pedestrian and bicycle railings and shall not be used where pedestrian or bicycle traffic is expected. A modified railing design meeting these requirements and using the Type 1 post design may be justified.

Use of Type A anchors, as detailed on the Standard Bridge Drawing, is not recommended. The Type B alternative is recommended because they are easier to install in a deck or box beam and easier to replace if damaged in a collision.

Designers should recognize that variable post lengths may be required along the length of a structure due to beam camber. A design data sheet is available from the Office of Structural Engineering to address these concerns.

304.3.3 TWIN STEL TUBE BRIDGE RAILING (TST-1-99)

This railing configuration was developed as a replacement to the Deep Beam Bridge Guardrail system on projects requiring a higher NCHRP acceptance level. The Twin Steel Tube Bridge Railing is for use over rural stream crossings on two (2) lane routes with an ADTT in one direction less than 2500 where the finished deck surface is less than 25 feet above the normal water surface elevation or final ground line. This system shall not be used on an overpass structure.

The standard configuration for this rail type does not meet the minimum requirements specified by AASHTO for pedestrian and bicycle railings and shall not be used where pedestrian or bicycle traffic is expected. A modified railing design meeting these requirements may be justified.

The required bridge terminal assembly section used to transition from Type 5 or 5A approach roadway guardrail to the bridge railing is detailed on Standard Construction Drawing GR-3.6.

The typical post spacing is 6'-3". The standard drawing enables the designer to reduce the first, last and one additional post spacing per span on each side of the bridge to account for construction clearances. The designer should carefully review the position of the posts that are near the corner of a structure for possible interference with wingwalls, tie rods, etc. For box beam bridge types, post spacing dimensions shall be referenced to each box beam end.

The site plan shall show the station of the center of the first inlet-mounted post on each corner of the bridge.

304.3.4 BRIDGE RETRO-FIT RAILING, THRIE BEAM BRIDGE RAILING FOR BRIDGES WITH SAFETY CURBS (TBR-91)

Thrie beam railing, as described on Standard Bridge Drawing TBR-91, is for use as a provisional upgrade on structures with safety curb and parapets where a safety upgrade is required under Section 304.1, and the structure will be rehabilitated or replaced in the near future.

The Office of Structural Engineering does not generally recommend this alternative because of the potential for high maintenance costs. A more suitable alternative is concrete refacing of existing safety curb and parapets to either a New Jersey or Single Slope shape. See Section 400 of this Manual for additional information on refacing of safety curb and parapets.

304.3.5 PORTABLE CONCRETE BARRIER (PCB-91)

This system is for use on construction projects to protect project personnel and to provide a temporary barrier system when a permanent bridge railing system does not exist. Application guidelines for PCB-91 are provided in Design Data Sheet, PCB-DD, available at the Office of Structural Engineering web site.

The designer is required to detail the installation requirements, including the number of anchor bolts per barrier, in the bridge plans. The pay item for this barrier system is Item 622 - Portable Concrete Barrier, 32 inch, Bridge Mounted. Although temporary railing is to be specified and completely described in the bridge plans, temporary railing is a roadway item and shall be included in the roadway quantities.

On projects where maintaining minimum lane widths during a construction phase is not possible due to limited bridge width, the use of a top mounted steel post and tubular steel rail system, similar to the Twin Steel Tube bridge guardrail, may be justified. The railing, post and anchorage designs of these systems are to be in accordance with the AASHTO LRFD Bridge Design Specifications, 2nd Edition, Sections A13.1-3.

304.3.6 BRIDGE SIDEWALK RAILING WITH CONCRETE PARAPETS (BR-2-98)

This railing system is for use on bridges with sidewalks at least 5'-0" wide and a curb height of 8 inches. Although this system is essentially a combination railing system, it may also be used without a sidewalk in applications where pedestrian traffic is not a concern.

Where Vandal Protection Fencing is required, the fencing shall be installed behind the steel tubing as shown in Figure 327. However, the steel tubing may be omitted if the concrete parapet height is 32" or greater. See Figure 326. If the tubing is omitted, the fencing should extend the full length of the concrete parapet and the additional 18" parapet height at each end, as detailed in the standard, is not required.

The concrete parapet shall be designed and detailed as follows:

A. All horizontal reinforcing steel shall be detailed as continuous for the total length of the structure.

B. Crack control joints shall be sawed into the concrete parapets. The distance between the saw-cut joints on the structure shall be between 6'-0" and 10'-0". The detailed locations of the crack control joints and vertical reinforcing bars shall be shown in the contract plans.

C. The saw-cut crack control joint shall be detailed as 1 ¼ inch deep and shall be filled with a polyurethane or polymeric material conforming to ASTM C920, Type S. The bottom one-half inch of both the inside and outside face shall be left unsealed to allow any water that enters the joint to escape. This requirement is established in the Standard Bridge Drawing; however, a plan note is required for special designs. See Section 600.

304.3.7 DEEP BEAM BRIDGE RETROFIT RAILING (DBR-3-11)

This system has been accepted by FHWA as a TL-3 compliant railing. The DBR-3-11 railing system is intended solely as an upgrade for existing Deep Beam Bridge Guardrail (DBR-2-73) installations and shall be specified on all bridge projects with existing DBR-2-73 railing that require at least TL-3 acceptance level according to BDM Section 304.1. The use of the AASHTO "Guide Specifications for Bridge Railing" will not be permitted.

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305 FENCING

305.1 GENERAL

The primary purposes of protective fencing are to provide for the security of pedestrians and to discourage the throwing or dropping of objects from bridges onto lower roadways, railroads, boat lanes or occupied property. In addition, fence may be needed on high level bridges where wind may threaten to blow pedestrians or occasional stranded motorists off the bridge and on bridges where there is a danger that the outside parapet may be mistaken for a median barrier, causing persons to jump over the parapet in emergency situations in periods of darkness. These situations should be treated on a case-by-case basis.

Since a falling object problem could occur at any bridge accessible to pedestrians, it is necessary to consider installation of protective fencing at such locations.

Generally, fencing attached to bridge structures for the protection of traffic and pedestrians should conform to the Vandal Protection Fencing Standard Bridge Drawing. The designer may need to enhance this standard to deal with requirements for the specific structure.

305.2 WHEN TO USE

Designers shall investigate the need for fencing during the Red Flag Summary when a bridge is included in the one of the following construction project types: new construction, complete deck replacements, replacement of deteriorated concrete deck edges, superstructure widenings and rigid concrete overlays. Pedestrian Fencing may be required when a total of 10 points or greater is achieved for a structure according to the following criteria. The designer should use this procedure as a general guide as to the need for fencing. The affected district should also be consulted for their input. The list is not to be construed as all-inclusive. Other rationale may be used on a case-by-case basis. Similarly, retrofitting of bridges that qualify according to the total index number is not mandatory if adequate justification for not doing so can be documented.

for the remaining piling represented by the testing. Submit all test results to the Office of Structural Engineering.

For subsequent static load tests, upon completion of a 10,000 ft [3000 m] increment of driven length, repeat the above procedure for the initial static load test. If necessary, the Engineer will revise the driving criteria for the remaining piling accordingly.

When performing the restrike, if the pile has not reached the blow count determined for the plan specified Ultimate Bearing Value, continue driving the pile until this capacity is achieved.

Provide the following note when battered piles are specified.

[30d] BATTERED PILES: The blow count for battered piles shall be the blow count determined for vertical piles of the same Ultimate Bearing Value divided an efficiency factor (D). Compute the efficiency factor (D) as follows:

$$D = \frac{1 - UG}{\sqrt{\left(1 + G^2\right)}}$$

U = Coefficient of friction, which is estimated at 0.05 for double-acting air operated or diesel hammers; 0.1 for single-acting air operated or diesel hammers; and 0.2 for drop hammers.

G = Rate of batter (1/3, 1/4, etc.)

606.3 STEEL PILE POINTS

Use the following note where steel points are required, and see Section 202.2.3.2.a.

[31] ITEM 507, STEEL POINTS, AS PER PLAN: Use steel pile points to protect the tips of the proposed steel “H” piling. Furnish steel points from the following manufactures/suppliers: Associated Pile and Fitting Corporation, 262 Rutherford Blvd., Clifton, New Jersey 07014, phone: (973)773-8400, (800)526-9047, fax: (973)773-8442; International Construction Equipment, Inc., 301 Warehouse Drive, Matthews, North Carolina 28015, phone: (704)821-8200, (888)423-8721, fax: (704)821-8201; Dougherty Foundation Products, Inc., P.O. Box 688, Franklin Lakes, New Jersey 07417, phone: (201)337-5748, fax: (201)337-9022; Versa Steel Inc., 1618 N.E. First Ave., Portland, Oregon 97232, phone: (503)287-9822, (800)678-0814, fax: (503)287-7483; Versabite Piling Accessories, 1704 Tower Industrial Dr., Monroe, North Carolina 28110, phone: (800)280-9950, (704)225-1566, fax: (704)225-1567; or by a manufacturer that can furnish a steel point that is acceptable to Director. The material used for the manufacturing of pile points shall conform to ASTM A27/A27M 65/35 [450/240] – Class 2 – Heat Treated or AASHTO M103/M103M 65/35 [450/240] – Heat Treated. Weld the pile points to the pile in accordance with AWS D1.5 or the manufacturer's written welding procedure supplied to the engineer before the welding is performed. Submit a notarized copy of the mill test report to the Engineer.

606.4 PILE SPLICES

Provide the following note when H-piles are specified.

[100] PILE SPLICES: In lieu of using the full penetration butt welds specified in CMS 507.09 to splice steel H-piles, the Contractor may use a manufactured H-pile splicer. Furnish splicers from the following manufacturer:

Associated Pile and Fitting Corporation

8 Wood Hollow Rd. Plaza 1

Parsippany, New Jersey 07054

Install and weld the splicer to the pile sections in accordance with the manufacturer's written assembly procedure supplied to the Engineer before the welding is performed.

606.5 MINIMUM HAMMER SIZE

[33] Note retired - see appendix

606.6 PILE ENCASEMENT

The following note shall be used where capped pile piers and steel "H" piles are being used for a bridge structure crossing a waterway. The exposed steel piling corrodes at the waterline, or near there. The note should not be used if the capped pile pier standard drawing is being used as standard drawing already specifies pile encasement methods.

[34] ITEM SPECIAL - PILE ENCASEMENT
Encase all steel H-piles for the capped pile piers in Class C concrete. Provide a concrete slump between 6 to 8 inches with the use of a superplasticizer. Place the concrete within a form that consists of polyethylene pipe (707.33), or PVC pipe (707.42). The encasement shall extend from 3 feet [1 meter] below the finished ground surface up to the concrete pier cap. Position pipe so that at least 3 inches [75 mm] of concrete cover is provided around the exterior of the pile.

In lieu of encasing the pile in concrete, galvanize the piles according to 711.02. The galvanizing shall be continuous from a minimum of 3 feet below the finish ground surface up to the concrete pier cap. The galvanized coating thickness shall be a minimum of 4 mils [100 μm]. Repair all gouges, scrapes, scratches or other surface imperfections caused by the handling or the driving of the pile to the satisfaction of the Engineer.

The Department will measure pile encasement by the number of feet. The Department will determine the sum as the length measured along the axis of each pile from the

SECTION 900 – BRIDGE LOAD RATING

901 PURPOSE

The purpose of this Section is to provide consistency and uniformity in procedures, guidelines and policies for determining safe live load carrying capacity or load rating of the highway bridges in the State of Ohio.

902 SCOPE

The guidelines, policies and recommendations provided in this Section are meant to assist Bridge Owners and bridge raters by establishing evaluation practices that meet the Ohio Revised Code (ORC), the National Bridge Inspection Standards (NBIS), ODOT Bridge Design Manual (BDM) and American Association of State Highway Transportation Officials (AASHTO). The intent is to establish standardized load rating procedures to conform FHWA reporting requirements and posting of bridges throughout the State of Ohio.

903 APPLICABILITY

The provisions of this Section apply to all highway structures in Ohio, which qualify as bridges in accordance with the definition for a bridge set in this Section. These provisions may be applied to smaller structures which do not qualify bridges, as such.

904 QUALITY MEASURES

To maintain the accuracy and consistency of load rating, the bridge owners should implement appropriate quality assurance and quality control (QA/QC) measures. Typical quality control procedures include the use of checklists to ensure uniformity and completeness, the review of reports and computations by a person other than originating individual and periodic field review of the inspection teams and their work.

Each load rating analysis shall be performed and reviewed by two different individuals. One of them shall be a Professional Engineer (PE) registered in the state of Ohio. The same PE shall then sign and stamp (seal) the final load rating report before submission to the bridge owner.

905 DEFINITIONS AND TERMINOLOGY

ASR: Allowable Stress Rating (also known as Working Stress Rating)

ADTT: Average Daily Truck Traffic volume in one direction

Bridge: A structure including supports over a depression or an obstruction such as water, highway, or railway; having a roadway to carry vehicular traffic and having an opening measured along the centerline of the roadway of 10 ft. [3.048 m] or more between under-copings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes. It may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening.

Bridge Management System (BMS): A system designed to optimize the use of available resources for the inspection, maintenance, rehabilitation, and replacement of bridges

Bridge Owner: A public or private entity that has jurisdiction over the bridge

Buried structure: A structure, including a flat slab, an arch, a frame, a box section, etc., that has a fill or pavement material of 2 ft. [600 mm] or more on top of it

Collapse: A major change in the geometry of the bridge rendering it unfit for its intentional use

Condition Rating: The result of the assessment of the functional capability and the physical condition of bridge components by considering the extent of deterioration and other defects. Generally, Condition Rating is evaluated on a scale "0" through "9" (where "9" is the best) and also referred to as General Appraisal

Exemption List: A list of structures exempt from the requirements of load rating given in this section

Failure: A condition where a limit state is reached or exceeded. This may or may not involve collapse or other catastrophic occurrences

FHWA: Federal Highway Administration – U.S. Department of Transportation

Inventory Rating: Load ratings based on the inventory level allow comparisons with the capacity for new structures and, therefore result in a live load, which can safely utilize a structure for an indefinite period of time

Health Index: An indicator of the structural health of an element, a bridge or a group of bridges expressed as a value (0 to 100), where 0 corresponds to the worst possible condition and 100 corresponds to best possible condition

LFR: Load Factor Rating

Limit State: A condition beyond which a bridge or a component ceases to satisfy the criteria for which it was designed.

Load Effect: The response (axial force, shear force, bending moment, torque, etc.) in a member or an element due to the loading

Load Factor: A load multiplier accounting for the variability of the loads, the lack of accuracy in analysis, and the probability of simultaneous occurrence of different loads

Load Rating: The determination of the live-load carrying capacity of a bridge

Long span bridge: Any single or multi span bridge that has at least one span greater than 200 ft. [61 m]

LRFD: Load and Resistance Factor Design

LRFR: Load and Resistance Factor Rating

NBI: National Bridge Inventory, the aggregation of structure inventory and appraisal data collection to fulfill the requirements of National Bridge Inspection Standards (NBIS)

NBIS: National Bridge Inspection Standards, Federal regulations establishing requirements for inspection procedures, frequency of inspection, a bridge inspection organization, qualification of personnel, inspection reports, and preparation and maintenance of bridge inventory records. The NBIS applies to all structures defined as NBIS bridges located on or over all public roads.

NBIS Bridge: A structure including supports over a depression or an obstruction such as water, highway, or railway; having a roadway to carry vehicular traffic and having an opening measured along the centerline of the roadway of more than 20 ft. [6.01 m] between under-copings of abutments or spring lines of arches, or extreme ends of openings for multiple boxes. It may also include multiple pipes, where the clear distance between openings is less than half of the smaller contiguous opening.

Nominal Resistance: Resistance of a component or connection to load effect, based on its geometry, permissible stresses, or specific strength of materials

Non-buried Structure: A structure, including a flat slab, an arch, a frame, a box section, etc., that have a fill or pavement material of less than 2'-0" [600 mm] on top of it.

ODOT: Ohio Department of Transportation

ODOT Bridge: A bridge in which ODOT has jurisdiction

Operating Rating: Load ratings based on the operating rating level generally describe the maximum permissible live load to which the structure may be subjected. Allowing unlimited numbers of vehicles to use the bridge at operating level may shorten the life of the bridge.

OPI: Organizational Performance Indices, A set of Indicators to measure the overall condition of bridges at the District or network level based on the several appraisal ratings

ORC: Ohio Revised Code (as amended and adopted)

OSE: ODOT Office of Structural Engineering

Owner: Agency having jurisdiction over the bridge

Pavement of a roadway: The pavement of a roadway includes all the paved or unpaved portions of a roadway including graded shoulders that may support vehicular traffic

PDF: Portable Document Format, a type of industry standard, electronic file format developed by the Adobe Corporation

Posting: Signing a bridge for load restriction

Preliminary Design Date: The date when Federal-aid funds are obligated for the studies or design activities related to identification of the type, size, and/or location of bridges. For ODOT projects following the Project Development Process (PDP), this date corresponds to the initiation of Step 1 for a Minimal Project, Step 3 for a Minor Project or Step 6 for a Major Project.

Quality Assurance: The use of sampling and other measures to assure the adequacy of quality control procedures in order to verify and measure the quality level of the entire bridge inspection and load rating program

Reliability Index: A computed quantity defining the relative safety of a structural element or structure expressed as the number of standard deviations that the mean of the margin of safety falls on the safe side.

Resistance Factor: A resistance multiplier accounting for the variability of material properties, structural dimensions, workmanship and the uncertainty in the prediction of resistance

RF: Rating Factor, an indicator of live load carrying capacity of a member or a bridge

Safe Load Capacity: A live load that can safely utilize a bridge repeatedly over the duration of a specified inspection cycle

Service Limit State: Limit state related to stress, deformation and cracking

Serviceability: A term that denotes restrictions on stress, deformation, and crack opening under regular service conditions

Serviceability Limit State: Collective term for service and fatigue limit states

Strength Limit State: Safety limit state relating to strength and stability

Superload: In Ohio, a Superload is any highway vehicular load with the total gross load equal to or more than 120,000 pounds (60 tons) or [54,431 kg].

Target Reliability: A desired level of reliability in a proposed evaluation

906 REFERENCES FROM OHIO REVISED CODE

References from the ORC related to bridge load rating, posting are given below:

5577.071 Reduction of weight of vehicle or load or speed on deteriorated or vulnerable bridge.

(A) When deterioration renders any bridge or section of a bridge in a county insufficient to bear the traffic thereon, or when the bridge or section of a bridge would be damaged or destroyed by heavy traffic, the board of county commissioners may reduce the maximum weight of vehicle and load, or the maximum speed, or both, for motor vehicles, as prescribed by law, and prescribe whatever reduction the condition of the bridge or section of the bridge justifies. This section does not apply to bridges on state highways.

(B) A schedule of any reductions made pursuant to division (A) of this section shall be filed, for the information of the public, in the office of the board of county commissioners in each county in which the schedule is operative. A board of county commissioners that makes a reduction pursuant to division (A) of this section shall, at least one day before a reduction becomes effective, cause to be placed and retained on any bridge on which a reduction is made, at both ends of the bridge, during the period of a reduced limitation of weight, speed, or both, signs of substantial construction conspicuously indicating the limitations of weight or speed or both which are permitted on the bridge and the date on which these limitations go into effect. No person shall operate upon any such bridge a motor vehicle whose maximum weight or speed is in excess of the limitations prescribed. The cost of purchasing and erecting the signs provided for in this division shall be paid from any fund for the maintenance and repair of bridges and culverts.

(C) Except as otherwise provided in this division, no reduction shall be made pursuant to division (A) of this section on a joint bridge as provided in section 5591.25 of the Revised Code unless the board of county commissioners of every county sharing the joint bridge agrees to the reduction, the amount of the reduction, and how the cost of purchasing and erecting signs indicating the limitations of weight and speed is to be borne. A board of county commissioners may make a reduction pursuant to division (A) of this section on a section of a joint bridge, without the agreement [of] any other county sharing the bridge, if the section of the bridge on which the reduction is to be made is located solely in that county.

5591.42 Carrying capacity of bridges - warning notice.

The board of county commissioners together with the county engineer or an engineer to be selected by the board, or the director of transportation, may ascertain the safe carrying capacity of the bridges on roads or highways under their jurisdiction. Where the safe carrying capacity of any such bridge is ascertained and found to be less than the load limit prescribed by sections 5577.01 to 5577.12 of the Revised Code, warning notice shall be conspicuously posted near each end of the bridge. The notice shall caution all persons against driving on the bridge a loaded conveyance of greater weight than the bridge’s carrying capacity.

Effective Date: 11-02-1989

907 BRIDGE FILES (RECORDS)

Bridge owners should maintain a complete, accurate and current record of each bridge under their jurisdiction. Complete information, in good usable form, is vital to the effective management of bridges. Such information provides a record that may be important for repair, rehabilitation, replacement and future planning of the bridges.

Items that should be assembled as part of the bridge record are discussed below. Some or all of the information pertaining to a bridge may be stored in electronic format as part of a bridge management system.

907.1 CONSTRUCTION PLANS

Each bridge record should include one clear and readable set of all drawings used to construct, repair and/or rehabilitate the bridge. In lieu of hard copies, the construction plans may be stored in an electronic format in such a way that clear and readable paper copies can easily be reproduced from the electronic records.

907.2 CONSTRUCTION & MATERIAL SPECIFICATIONS

Each bridge record should include the reference to the construction and material specification used during the construction of the bridge. Where general technical specifications were used, only the special technical provisions need to be incorporated in the bridge record.

907.3 SHOP AND WORKING DRAWINGS

One set of all shop and working drawings approved for the construction or repair of a bridge should be saved or preserved as a part of the bridge record.

907.4 AS-BUILT DRAWINGS

Each bridge record should include one set of final drawings showing the “as-built” condition of the bridge, complete with signature of the individual responsible for recording the as-built conditions.

907.5 CORRESPONDENCE

Include all pertinent letters, memoranda, notice of project completion, telephone memo and other related information directly concerning the bridge in chronological order in the bridge record.

907.6 INVENTORY DATA

A complete inventory of a bridge in the ODOT BMS shall be done as soon as a bridge is open to traffic. FHWA mandates an ODOT bridge shall be inventoried within 90 days and a Non-ODOT bridge shall be inventoried within 180 days from the day the bridge was open to traffic. The same rule applies to modifications in the inventory record of replaced bridges or the bridges that have been reopened after the repairs are done. Initial inventory can be completed using the bridge plans. However, a history of dates of physical closing or opening of the traffic on the bridge should be maintained in the bridge record.

907.7 INSPECTION HISTORY

Each bridge record should include a chronological record of the date and the type of all inspections performed on the bridge. When available, scour, seismic, wind and fatigue evaluation studies; fracture critical information; deck evaluations; field load testing; and corrosion studies should be part of the bridge record.

907.8 PHOTOGRAPHS

Each bridge record should at least contain photographs of the bridges showing, top view, approach views and the elevation. Other photos necessary to show major defects, damages, or other important features, such as utilities on or under the bridge, should also be included.

907.9 RATING RECORDS

The bridge record should include a complete record of the determination of the bridge's load-carrying capacity.

907.10 ACCIDENT DATA

Details of accidents or damage occurrences, including date, description of accident, member damage and repairs, supported by photographs and investigation reports should be included in the bridge record.

907.11 MAINTENANCE AND REPAIR HISTORY

Each bridge record should include a chronological record documenting the maintenance and repairs that have occurred since the initial construction of the bridge. Include details such as date, description of project, contractor cost and related data for in-house projects.

907.12 POSTING HISTORY

Each bridge record should include a summary of all posting actions taken for the bridge, including load capacity calculations, date of posting and description of signing used.

908 GENERAL

The provisions of BDM Section 900 apply to ODOT bridges. All provisions of BDM Section 900 may also be applied to Non-ODOT bridges at the discretion of the bridge owner.

For load rating of new bridges, BDM Sections 911 through 926 shall apply.

For load rating of existing bridges, BDM Sections 911 through 925 & 927 shall apply.

909 UNIT WEIGHTS & DENSITIES

The following assumptions should be made while performing the load rating analysis, unless more accurate site information is available:

A. Unit weight of asphalt .... 145 lb/ft^3 [22.8 kN/m^3]

B. Unit weight of concrete .... 150 lb/ft^3 [23.6 kN/m^3]

C. Unit weight of latex modified concrete .... 150 lb/ft^3 [23.6 kN/m^3]

D. Unit weight of soil .... 120 lb/ft^3 [18.9 kN/m^3]

E. Unit weight of steel .... 490 lb/ft^3 [77.0 kN/m^3]

F. Water density .... 62.4 lb/ft^3 [9.8 kN/m^3]

910 STRUCTURES EXEMPT FROM LOAD RATING

Following types of buried structures are exempt from load rating under the provisions of this Section.

A. Circular plastic pipes

B. Concrete pipes (circular, or elliptical)

C. Buried metal frames

D. Junction chambers

E. Manholes

F. Inlets and outlets

911 WHICH PORTION OF BRIDGES SHALL BE LOAD RATED

Any bridge or structural member of a bridge that would carry highway traffic shall be load rated. Members of substructures need not be routinely checked for load capacity. Substructure elements such as pier caps and columns should be checked in situations where the owner or the rating engineer has reason to believe that their capacity may govern the capacity of the bridge.

912 PROCEDURE FOR RATING

A. The relative strength ratings for each bridge shall be determined in the following manner:

1. A careful field inspection of the existing bridge shall be made by the District Bridge Engineer and/or other qualified structural engineer to determine its condition, and the percent of effectiveness of the various members for carrying load. All information shown in the Bridge Inventory and Inspection Records shall also be carefully checked and revised as necessary to show the current condition of the bridge.
2. New (proposed) bridges shall be load rated at the design stage per BDM Section 926
3. Using pertinent current information, the District Bridge Engineer/Bridge Owner shall determine the Inventory, Operating, and Ohio Legal Load Ratings.
4. The yield stresses for the construction materials in older bridges, for which plan information is not available, can generally be determined using the date of construction.
5. For a load rating analysis request on an ODOT bridge, the District Bridge Engineer shall submit to the OSE, Bridge Rating Engineer a complete inspection report (including comments), bridge photographs, field measurements and a copy of the previous rating calculation sheets or computer input data sheets.
6. The Bridge Rating Engineer shall review the submitted material, analyze bridge and return a copy of the final calculations or computer output to the District Bridge Engineer, along with any recommendations concerning the proposed ratings.
7. The District Bridge Engineer shall keep the final calculations or computer output along with any recommendations concerning the proposed ratings on file.

913 WHEN LOAD RATING SHALL BE REVISED

The load rating of a bridge should be revised when:

A. There is a physical change in the condition of a structural member of the bridge

B. Rusting or damage to a slab, beam, girder or other structural element that has resulted in section loss

C. There is structural damage to steel, like a hit by a vehicle, excessive deflection or elongation under temperature or highway loads

D. When the inspection general appraisal rating of the superstructure of a bridge drops below 5

E. There is an addition of a new beam or girder

F. A new deck is added or the existing deck width is changed

G. There is a change in the dead load on the superstructure, like addition or removal of wearing surfaces, addition or removal of sidewalks, parapets, railings, etc.

The load rating of a bridge does not need to be revised when:

A. The change in the thickness of external wearing surface is less than 1 inch [2.54 cm]

B. The change in the dead load on a beam member is not more than 10 pounds per ft.

914 ANALYSIS OF BRIDGES WITH SIDEWALKS

A pedestrian load of 75 pounds per square feet shall be applied to all sidewalks wider than 2.0 ft. and considered simultaneously with the live load in the vehicle lane.

When pedestrian load is present, the pedestrian load effect should be subtracted from the capacity of the member at the location being investigated while calculating the RF.

For bridges load rated according to the AASHTO Standard Specifications for Highway Bridges, AASHTO Table 3.22.1A applies. For bridges load rated according to the AASHTO LRFD Bridge Design Specifications, refer to BDM Section 925.2.

Pedestrian load shall not be considered in Special or Permit Load Analysis per BDM Section 916.

915 ANALYSIS OF MULTILANE LOADING

Traffic lanes to be used for rating purposes shall be in accordance with AASHTO.

AASHTO reduction factors for multiple lane loadings shall be applied where appropriate.

For rating analysis of floor beams, trusses, non-redundant girders or other non-redundant main structural members, position identical rating vehicles in one or more of the through traffic lanes on the bridge, spaced and shifted laterally on the deck, within the traffic lanes, so as to produce the maximum stress in the member under consideration.

916 ANALYSIS FOR SPECIAL LOAD OR SUPERLOAD

When a structure is required, in the Scope of Services, to be analyzed for special or Superload vehicle, a second analysis shall be performed for a single lane loading of the special or Superload vehicle condition. The special or Superload vehicle shall be placed laterally on the structure to produce maximum stresses in the critical member under consideration.

The analysis for special or Superload vehicle shall be performed at the operating level only.

917 LOAD RATING OF LONG SPAN BRIDGES

917.1 WHEN THE LOAD RATING SHALL BE DONE

Perform the load rating of long span bridges according to BDM Sections 926.3.3, 927.3.2, or 927.4.2.

917.2 HOW THE LOAD RATING SHALL BE DONE

917.2.1 INVENTORY & OPERATING LEVEL RATING USING HL-93 LOADING

The live load shall be applied as per AASHTO LRFD Design Specification.

917.2.2 INVENTORY & OPERATING LEVEL RATING USING HS20 TRUCK

The live load shall be applied as follows:

A. In the right-most lane, place a series of HS20 trucks to simulate a train of vehicles. The vehicle train shall consist of the HS20 trucks spaced with 30 ft. clear distance between the rear axle of the leading vehicle and the front axle of the trailing vehicle. The distance between the second axle and the rear axle shall be fixed at 14.0 ft. Place as many fixed-axle spacing HS20 trucks as necessary to produce the maximum load effect on the component to be rated. No partial HS20 trucks shall be used.

B. In all other lanes in the same direction, simultaneously place single, variable-axle spacing HS20 trucks positioned to produce the maximum load effect on the component to be rated. Apply the multiple presence factors, AASHTO Standard Specification for Highway Bridges - Section 3.12, accordingly.

C. For bridges with two-way traffic, apply the live load as described in A. and B. above to the lanes in the opposite direction.

917.2.3 OPERATING LEVEL RATING USING OHIO LEGAL LOADS

The provisions of BDM Sections 926 or 927 shall apply except the live load application shall be in accordance with BDM Section 917.2.3.1, 917.2.3.2 or 917.2.3.3.

917.2.3.1 BRIDGES WITH THREE OR MORE LANES

<u>If no permit vehicle is present, apply the following live load</u>:

A. In the right-most lane, place a series of Ohio 5C1 vehicles. The 5C1 vehicles should be spaced such that the distance between the rear axle of the leading vehicle and the front axle of trailing vehicle shall be 36 ft. Place as many 5C1 vehicles as necessary to produce the maximum load effect on the component to be rated. No partial 5C1 vehicles shall be used.

B. In all other lanes in the same direction, simultaneously place single 5C1 vehicles. These vehicles shall be positioned to produce the maximum live load effect on the component to be rated. Apply the multiple presence factors, AASHTO Standard Specification for Highway Bridges - Section 3.12, accordingly.

C. For bridges with two-way traffic, apply the live load for the opposing traffic in the same manner as the one-way traffic.

<u>If a permit load vehicle is present, apply the following live load</u>:

A. In the right-most lane, place one permit load vehicle positioned to produce the maximum live load effect on the component to be rated. In the adjacent lane, place a series of Ohio 5C1 vehicles. The 5C1 vehicles should be spaced such that the distance between the rear axle of the leading vehicle and the front axle of trailing vehicle shall be 36 ft. Place as many 5C1 vehicles as necessary to produce the maximum load effect on the component to be rated. No partial 5C1 vehicles shall be used.

B. In all other lanes in the same direction, simultaneously place single 5C1 vehicles. These vehicles shall be positioned to produce the maximum live load effect on the component to be rated. Apply the multiple presence factors, AASHTO Standard Specification for Highway Bridges - Section 3.12, accordingly.

C. For bridges with two-way traffic, place a series of Ohio 5C1 vehicles in the right-most lane. The 5C1 vehicles should be spaced such that the distance between the rear axle of the leading vehicle and the front axle of trailing vehicle shall be 36 ft. Place as many 5C1 vehicles as necessary to produce the maximum load effect on the component to be rated. No partial 5C1 vehicles shall be used. In all remaining lanes, simultaneously place single 5C1 vehicles. These vehicles shall be positioned to produce the maximum live load effect on the component to be rated. Apply the multiple presence factors, AASHTO Standard Specification for Highway Bridges - Section 3.12, accordingly.

917.2.3.2 BRIDGES WITH TWO LANES

<u>If no permit vehicle is present, apply the following live load</u>:

A. In the right-most lane, place a series of Ohio 5C1 vehicles. The 5C1 vehicles should be spaced such that the distance between the rear axle of the leading vehicle and the front axle of trailing vehicle shall be 36 ft. Place as many 5C1 vehicles as necessary to produce the maximum load effect on the component to be rated. No partial 5C1 vehicles shall be used.

B. For bridges with one-way traffic, in the other lane simultaneously place a single 5C1 vehicle positioned to produce the maximum live load effect on the component to be rated.

C. For bridges with two-way traffic, in the other lane place a series of Ohio 5C1 vehicles. The 5C1 vehicles should be spaced such that the distance between the rear axle of the leading vehicle and the front axle of trailing vehicle shall be 36 ft. Place as many 5C1 vehicles as necessary to produce the maximum load effect on the component to be rated. No partial 5C1 vehicles shall be used.

If a permit load vehicle is present, apply the following live load:

A. In the right-most lane, place one permit load vehicle positioned to produce the maximum live load effect on the component to be rated.

B. In the other lane, place a series of Ohio 5C1 vehicles. The 5C1 vehicles should be spaced such that the distance between the rear axle of the leading vehicle and the front axle of trailing vehicle shall be 36 ft. Place as many 5C1 vehicles as necessary to produce the maximum load effect on the component to be rated. No partial 5C1 vehicles shall be used.

917.2.3.3 BRIDGES WITH A SINGLE LANE

If no permit vehicle is present:

The live load shall be a series of Ohio 5C1 vehicles. The 5C1 vehicles should be spaced such that the distance between the rear axle of the leading vehicle and the front axle of trailing vehicle shall be 36 ft. Place as many 5C1 vehicles as necessary to produce the maximum load effect on the component to be rated. No partial 5C1 vehicles shall be used.

If a permit vehicle is present:

The live load shall be the one permit vehicle positioned to produce the maximum live load effect on the component to be rated.

918 BRIDGE POSTING FOR REDUCED LOAD LIMITS

918.1 PURPOSE

The Procedure outlined in this section is to be followed for posting warnings of bridge strength deficiencies on ODOT bridges.

918.2 REFERENCE

Ohio Revised Code, Section 5591.42:

918.3 PROCEDURE FOR BRIDGE POSTING

A. When the Operating Rating of the bridge is determined to be less than 100% of the Ohio legal load and the bridge cannot be strengthened immediately to a rating of 100% or above, the following procedures shall be used:

1. The District Bridge Engineer shall:
   a. Establish a rating and submit to the OSE Bridge Rating Engineer, a written request for the bridge posting. (See BDM Section 918.6 for required content of request.)
   b. After the Director signs the posting request, the District Roadway Services Manager shall prepare, erect and maintain all necessary signs until the bridge is either strengthened or replaced.
2. The District Bridge Engineer shall update all Bridge Inventory and Inspection records to show the latest official posted capacity.
3. After the posting request is signed, the Bridge Rating Engineer shall send a copy to the: District Bridge Engineer; Manager, Hauling Permits Section of the Office of Highway Management; Superintendent of State Highway Patrol; Executive Director Ohio Trucking Association; the Board of County Commissioners; and the County Engineer where the bridge is located.

B. Special treatment shall be applied to legal load ratings of 95% or higher and also to legal load ratings of 15% or less as follows:
   1. Because of the use of some judgmental data in the rating computations, bridges with a calculated load reduction of 5% or less, after rounding, shall not be posted. These bridges shall be rated at 100% of legal load.
   2. For calculated load reductions of 85% or more, after rounding, the bridge must be considered for "closing" to all traffic until it can be rehabilitated or replaced.

C. Where posting of a bridge is determined necessary and no unusual or special circumstance at the bridge dictates otherwise, Ohio standard regulatory signs shall be placed in sufficient numbers and at the specific locations required below.
   1. Example of standard wording to be used on signs is given in Figure 905.
   2. Bridge Ahead signs shall be erected at intersecting state roads located just prior to the bridge to allow approaching vehicles to by-pass the bridge or turn around safely with a minimum of interference to other traffic.
   3. Bridge Weight Limit signs shall be erected at each end of the bridge.

Table 918.3-1: ODOT Bridge Posting Policy

Controlling RF = Min. RF of Ohio Legal Loads at Operating Stress Level % Ohio Legal Value = Controlling RF x 100		
% Ohio Legal Value	**Reported % Ohio Legal in BMS**	**Posting for Reduced Loads Needed**
≥150%	150%	NO
≥100% and <150%	Actual percentage rounded to the nearest 5 (i.e. 100, 105, 110, 115, etc.)	NO
≥92.5% and <100%	100%	NO
<92.5%	Actual percentage rounded to the nearest 5 (starting with 90%, 85%, 80%, etc.)	YES

918.4 PROCEDURE FOR RESCINDING POSTING

A. When a posted bridge has been strengthened or replaced and no longer needs posting, the District Bridge Engineer shall forward to the Bridge Rating Engineer a written request to rescind the existing signed posting. The request shall include a complete statement of the reason for the action as specified in BDM Section 918.6.

B. The Bridge Rating Engineer shall review the data submitted by the District Bridge Engineer and upon concurrence shall forward to the Director a request to rescind the posting.

C. The Bridge Rating Engineer shall distribute copies of the rescind notice as described in Section 918.3.A.3.

918.5 PROCEDURE FOR CHANGING POSTING

When the rated capacity of bridge changes, so as to require a revised posting level, the procedures in BDM Section 918.3 apply and in addition, the existing posting must be rescinded as set forth in BDM Section 918.4.

918.6 REQUIRED INFORMATION FOR POST, RESCIND AND CHANGE REQUESTS

The following minimum information is required on all post, rescind and change requests:

A. Posting Request (Reduction in Load Limits)
   1. County in which bridge is located
   2. Current Bridge Number
   3. Structure File Number
   4. Feature intersected (over or under bridge)
   5. Tonnage unit requested for the four typical legal vehicles.
   6. Existing rating of bridge expressed as a percent of legal load or tons.
   7. Explanation as to why posting is required
   8. Attach copies of all official documentation for any associated actions by involved agencies other than the state.

B. Rescinding Request (Removal of Existing Load Limits)
   1. County in which bridge is located
   2. Current Bridge Number
   3. Structure File Number
   4. Feature intersected (over or under bridge)
   5. Existing posting (% reduction or weight limit currently in effect)
   6. Date existing posting was effective
   7. Explanation as to why posting restrictions can now be removed (show contract project numbers or indicate force account or other work method used to correct problem)
   8. New load rating for the rehabilitated or new structure

C. Change Request (Revision of Existing Posted Limits)
   1. County in which bridge is located
   2. Current Bridge Number
   3. Structure File Number
   4. Feature intersected (over or under bridge)
   5. Existing posting (weight limit currently in effect)
   6. Revised posting request
   7. Date of existing posting
   8. Explanation as to why posting change is necessary (include project numbers etc.

involved)

919 SOFTWARE TO BE USED FOR LOAD RATING

One of the following computer programs to be used for the load rating of bridges, as applicable.

A. AASHTO Virtis: Virtis is a load rating and analysis product developed and licensed by AASHTO. Virtis can rate the bridges by LRFR and LFR methods. It is one of ODOT's preferred programs to do load rating.

(http://aashto.bakerprojects.com/virtis/).

B. Bentley LARS: LARS is bridge analysis software maintained and licensed by the Bentley Systems. It can load rate bridges by LRFR and LFR methods. It is one of ODOT's preferred programs to do load rating. (http://www.bentley.com)

C. AASHTO BARS-PC: BARS-PC is the default bridge analysis and load rating program by LFR method for all bridges designed prior to October 1, 2010. BARS-PC program is available from ODOT for a nominal charge of material and shipping. It is one of ODOT's preferred programs to do load rating.

D. BRASS-Culvert: BRASS-Culvert can load rate reinforced concrete flat-topped 3-sided frames and 4-sided boxes buried under the fill by LRFR and LFR methods. BRASS-Culvert software shall be used for the analysis of concrete box sections and three sided concrete frames. BRASS family of programs is developed, maintained and licensed by the Wyoming Department of Transportation. It is one of ODOT's preferred programs to do load rating.

(http://www.dot.state.wy.us/wydot/engineering_technical_programs/bridge/brass)

E. LARSA 4D: Finite element analysis programs by LARSA, Inc., 105 Maxess Road, Melville Corporate Center, Suite 115N, Melville, NY 11474 (http://www.larsausa.com).

F. DESCUS I: DESCUS I can perform analysis of horizontally curved flanged steel sections which act compositely or non-compositely with a concrete deck. The program can be run using Load Factor or Load and Resistance Factor method.

(http://best.umd.edu/software/descus-i/)

G. MDX Software: MDX software can be used to design and load rate straight and curved steel bridges. The program can be run using Load Factor or Load and Resistance Factor method.

(http://www.mdxsoftware.com/)

For the analysis of arches and other special structures that cannot be modeled using any of the programs A through D above, contact the OSE for pre-approval of the software before use.

Also, contact the OSE prior to using any computer program other than A through E above. The Department will not accept load rating performed using any software not pre-approved for that bridge.

920 LOAD RATING REPORT SUBMISSION

The load rating report shall be submitted to the project manager, District Bridge Engineer or the respective owner (in case of a non-ODOT bridge). The submission shall include two (2) printed copies and one electronic copy of the Load Rating Report and one copy of the electronic input data files. The Load Rating Reports shall be signed, sealed and dated by an Ohio Registered Engineer.

For an ODOT-bridge the District Bridge Engineer will send one printed copy, an electronic copy of the report, the electronic data files and a copy of the final bridge plans to the OSE for review.

The report must list final inventory and operating ratings of each main bridge member, overall ratings of each structure unit (mainline, ramps, etc.), and the final ratings of the entire bridge summarized in a tabular form. The ratings of each member and the overall ratings of the structure shall be presented for each Ohio Legal Load and either AASHTO HS20-44 or HL-93 live load.

An example of a Load Rating Report Summary is given as Figure 908.

For existing bridges, the report shall state how the material properties were determined. Any specific details about the current conditions and bridge geometry shall be listed.

All calculations related to the load rating should be a part of the load rating report.

Submit copies of the input & output computer files in electronic format. Input files must be error free and ready to be run. The rating engineer shall incorporate any changes in the input files as a result of ODOT review.

921 LOAD RATING USING AASHTO VIRTIS PROGRAM

921.1 GENERAL

Virtis is a load rating program licensed from AASHTO. Virtis runs on Microsoft Windows and can load rate a variety of bridges by LFR as well as LRFR methods.

Virtis Vehicle library can be customized to include ODOT Legal Loads. Alternatively Virtis library can be requested from OSE.

921.2 VIRTIS LOAD RATING REPORT SUBMISSION

The load rating report shall be submitted to the project manager, District Bridge Engineer or the respective owner (in case of a non-ODOT bridge). The submission shall include two (2) printed copies and one electronic copy of the Load Rating Report and one copy of the electronic input data files. The Load Rating Reports shall be signed, sealed and dated by an Ohio Registered

Engineer.

For an ODOT-bridge the District Bridge Engineer or Project Manager shall send a printed copy & an electronic copy of the report, the electronic data files and a copy of the final bridge plans to the OSE for review.

The report must list final inventory and operating ratings of each main bridge member, overall ratings of each structure unit (mainline, ramps, etc.), and the final ratings of the entire bridge summarized in a tabular form.

An example of a Load Rating Summary Report is given as Figure 908.

For existing bridges, the report shall state how the material properties were determined. Any specific details about the current conditions and bridge geometry shall be listed.

All calculations related to the load rating should be included as a part of the load rating report.

921.3 VIRTIS COMPUTER INPUT AND OUTPUT FILES

Submit the error-free and working electronic copies of the input file exported as an “XML” file. To get the electronic copy of a bridge data file in Virtis, open the “Bridge Workspace,” Export the bridge input file into an XML file and submit it electronically for review.

In addition to the electronic input data file, the rating report shall also include copies of the computer rating summary and the rating summary report. The rating report can be submitted as a “PDF” file or a printed hard copy.

922 LOAD ANALYSIS USING LARS PROGRAM

922.1 GENERAL

LARS (Load Analysis and Rating System) is a family of bridge load analysis and rating programs maintained and licensed by Bentley, Systems.

LARS can run on any Microsoft Windows compatible machine.

LARS can import BARS-PC files.

LARS Vehicle library can be customized to include ODOT Legal Loads.

922.2 LARS CAPABILITIES

LARS program can analyze and rate single and multiple span bridges by Allowable Stress; Load Factor; and Load & Resistance Factor methods.

922.3 LARS COMPUTER INPUT AND OUTPUT FILES

Follow the Report submission guidelines given in BDM Section 920.

Also submit the error-free and working electronic copies of the input & output files.

In addition to the electronic input data file, the rater may submit hard (printed) copies of the computer input and output files.

923 LOAD ANALYSIS USING BRASS-CULVERT PROGRAM

923.1 GENERAL

BRASS (Bridge Rating and Analysis System) is a family of several structural analysis modules, such as BRASS-Culvert, BRASS-Girder, BRASS-Pole, etc. BRASS-Culvert program can be used to analyze reinforced concrete three-sided flat-topped frames and four-sided box sections.

If haunch dimensions are different, use the smallest dimension in the analysis.

BRASS can run on any Microsoft Windows compatible machine.

BRASS data files should use the same naming convention as the BARS-PC data files.

BRASS Vehicle library can be customized to include ODOT Legal Loads.

923.2 BRASS CAPABILITIES

BRASS program can analyze single-cell and multi-cell reinforced concrete box structures and frames.

Technical support on BRASS program is available to the BRASS licensed users from the Wyoming Department of Transportation.

923.3 BRASS COMPUTER INPUT AND OUTPUT FILES

Follow the Report submission guidelines given in BDM Section 920.

Also submit the error-free and working electronic copies of the input & output files with extensions “dat,” “cus” and “xml.”

In addition to the electronic input data file, the rater may submit hard (printed) copies of the computer input and output files.

924 LOAD RATING ANALYSIS USING BARS-PC

924.1 GENERAL

The BARS-PC is the PC version of the AASHTO BARS (Bridge Analysis and Rating System) program that can analyze and load rate structures based on the AASHTO Standard Specifications for Highway Bridges.

BARS-PC program installation CD is available for use on ODOT Projects, from the OSE at a nominal cost.

The OSE will provide limited technical support to install and execute the program.

BARS-PC program is not compatible Windows 7 or later operating systems. BARS-PC cannot perform rating based on the LRFR method.

The types of material, methods of construction, bridge member and types of section that can be handled by BARS-PC are provided in the BARS User's Manual that can be downloaded from the OSE-Bridge Management website.

Figures 906 and 907 provide general information about ODOT Allowable Stresses in bending and shear and material strengths based on the year of construction. These material properties are different from those given in AASHTO BARS Manual 2, Appendix A. However, they are used as default values in the BARS-PC customization file prepared by ODOT, which is available from Structure Rating website. Any material stresses and specifications specified on the design plans shall supersede the values given in Figures 906 and 907.

The rater is cautioned to pay extra attention to the design plans and the year of construction, when determining material strengths for structures built during transition years of Figures 906 and 907 (e.g., for member type SS, years 1964-68, or 1988-93, etc.), as materials may have been substituted.

924.2 BARS-PC ANALYSIS – GENERAL GUIDELINES

All information in a BARS-PC input data file shall be entered in uppercase with "Caps Lock ON."

The first six digits from left of the Structural File Number (SFN) of the bridge with prefix "R" and extension "dat" shall be used as the input data file name. The same first six digits of the SFN shall be used as Structure Group ID No. on all BARS-PC data input cards. For example, if the SFN of a bridge is 4729854, the input file name should be named as "R472985.DAT" and the Structure Group ID No. will be "472985."

If a SFN has not been assigned to a new structure, contact Structure Inventory Section in the OSE to get a SFN for the structure.

All BARS-PC input files shall have the word “NEW” in columns 9-11 and the letter “X” in column 17 of card type AA.

All BARS-PC input files shall have the bridge rater’s initials and company/office abbreviations in the columns 15-22 of card type 01 and columns 9-16 of card type 02.

All structures rated by BARS-PC using LF method shall have letter “L” in column 65 of card type 05.

All structures rated by BARS-PC shall have letter “F” in column 66 of card type 05.

All structures rated using BARS program shall have a three-digit Structure Type Code in columns 41-46 of card type 02. The three-digit code shall be selected based on the material, type and the description of the main members according to Structure Type Codes of ODOT Bridge Inventory Coding Guide. For example, Concrete Slab Continuous shall be coded as “112" and Steel Beam Simple Span shall be coded as “321.”

The complete seven digit SFN shall be entered in columns 9-16 of card type 05.

The original method of construction and the loading used for the design of the bridge shall be explicitly stated on card type 06.

The assumptions made to model a structural member or unit for computer analysis shall also be stated on card type 06.

The live load distribution factors for the single lane loading shall be given on the card type 6.

If space on card type 06 (maximum of six cards of type 06) is not sufficient, additional information can be included with the load rating report for ODOT review.

BARS (mainframe) and BARS-PC programs do not recognize standard steel rolled beams, Prestressed I-girder or Prestressed box beam sections. Standard rolled beams shall be coded on card type 12 in terms of flange and web plates. Prestressed I-girders and box beams shall be coded on card type 15 with special attention given to the type, area and strength of the prestressing strands.

When using BARS-PC to load rate multi-span prestressed structures, each member shall be analyzed as a simply supported member.

924.3 BARS-PC LOAD RATING REPORT SUBMISSION

Follow the load rating report submission guidelines given in the BDM Section 920.

924.4 BARS-PC COMPUTER INPUT AND OUTPUT FILES

In addition to the electronic input data file, each copy of the rating report shall also include hard (printed) copies of the computer input and output files.

Some computer programs generate several output files during the process of analysis. Include those files that contain information. For example, the load rating analysis report of a steel beam bridge using BARS-PC shall contain printed copies of the following files:

A. lista.lis

B. rate2.lis

C. summary.lis

D. flex.lis

925 LOAD RATING OF BRIDGES USING LRFR SPECIFICATIONS

925.1 APPLICABILITY OF AASHTO DESIGN SPECIFICATIONS

This Section is consistent with the current AASHTO LRFD Bridge Design Specifications. Where this Section is silent, the current AASHTO LRFD Bridge Design Specification shall govern.

925.2 GENERAL LOAD RATING EQUATION

The following general equation shall be used in determining the load rating of each component and connection subject to a single force effect (axial force, flexure or shear) [MBE 6A.4.2]:

$$RF = \frac{C - (\gamma_{DC})(DC) - (\gamma_{DW})(DW) \pm (\gamma_{P})(P) - (\gamma_{PL})(PL)}{(\gamma_{LL})(LL)(1 + IM/100)}$$

For Strength Limit States:

$C = \varphi_c \cdot \varphi_s \cdot \varphi \cdot R_n$

Where the following lower limit shall apply:

$\varphi_c \cdot \varphi_s \geq 0.85$

For Service Limit States:

$C = f_R$

Where:

C = Capacity

DC = Dead load effect due to structural components and attachments

DW = Dead load effect due to wearing surface and utilities

f_R = Allowable stress specified in LRFD Code

IM = Dynamic load allowance expressed as percentage (%)

LL = Live Load effect

P = Permanent loads other than dead loads, such earth pressure, shrinkage etc.

PL = Pedestrian Load effect only to be applied when a sidewalk is present

RF = Rating Factor

R_n = Nominal member resistance

γ_{DC} = Load factor for DC load

γ_{DW} = Load factor for DW load

γ_p = Load factor for P load = 1.0

γ_{LL} = Evaluation live load factor

γ_{PL} = Load factor for Sidewalk load = 1.0

φ_c = Condition factor

φ_s = System factor

φ = LRFD Resistance factor

For Limit States and factors see BDM Section 925.3.

925.3 LIMIT STATES AND LOAD FACTORS FOR LOAD RATING

Strength is the primary limit state for load rating; service and fatigue limit states are selectively applied in accordance with the provisions of AASHTO Manual of Bridge Evaluation [MBE 6A.4.2]:

For Inventory and Operating Rating for AASHTO HL-93 Loading, use the following limit states and load factors:

Table 925.3-1: LRFR Design Load Limit States and Load Factors

Bridge Type	Limit State	Dead Load γ_{DC}	Dead Load γ_{DW}	HL-93 Loading Inventory γ_{LL}	HL-93 Loading Operating γ_{LL}
Steel	Strength I	1.25	1.50	1.75	1.35
	Service II	1.00	1.00	1.30	1.00
	Fatigue	0.00	0.00	0.75	
Reinforced Concrete	Strength I	1.25	1.50	1.75	1.35
Prestressed Concrete	Strength I	1.25	1.50	1.75	1.35
	Service III	1.00	1.00	0.80	
Wood	Strength I	1.25	1.50	1.75	1.35

For Rating for Ohio Legal Loads, use the following limit states and load factors:

Table 925.3-2: Legal Loads Limit States and Load Factors

Bridge Type	Limit State	Dead Load γ_{DC}	Dead Load γ_{DW}	Ohio Legal Loads γ_{LL}
Steel	Strength I	1.25	1.50	Unknown ADTT -- 1.80 ADTT ≥ 5000 -- 1.80 ADTT = 1000 -- 1.65 ADTT ≤ 100 -- 1.40
	Service II	1.00	1.00	For all ADTT -- 1.30
Reinforced Concrete	Strength I	1.25	1.50	Unknown ADTT -- 1.80 ADTT ≥ 5000 -- 1.80 ADTT = 1000 -- 1.65 ADTT ≤ 100 -- 1.40
	Service I	1.00	1.00	
Prestressed Concrete	Strength I	1.25	1.50	Unknown ADTT -- 1.80 ADTT ≥ 5000 -- 1.80 ADTT = 1000 -- 1.65 ADTT ≤ 100 -- 1.40
	Service III	1.00	1.00	1.00
Wood	Strength I	1.25	1.50	Unknown ADTT -- 1.80 ADTT ≥ 5000 -- 1.80 ADTT = 1000 -- 1.65 ADTT ≤ 100 -- 1.40

For Rating for Special and Permit Loads, use the following limit states and load factors:

Table 925.3-3: Permit Load Limit States and Load Factors

Bridge Type	Limit State	Dead Load γDC	Dead Load γDW	Permit or Special Loads γ_{LL}
Steel	Strength II	1.25	1.50	Unknown ADTT -- 1.80 ADTT ≥ 5000 -- 1.80 ADTT = 1000 -- 1.65 ADTT ≤ 100 -- 1.40
	Service II	1.00	1.00	1.00
Reinforced Concrete	Strength II	1.25	1.50	Unknown ADTT -- 1.80 ADTT ≥ 5000 -- 1.80 ADTT = 1000 -- 1.65 ADTT ≤ 100 -- 1.40
	Service I	1.00	1.00	1.00
Prestressed Concrete	Strength II	1.25	1.50	Unknown ADTT -- 1.80 ADTT ≥ 5000 -- 1.80 ADTT = 1000 -- 1.65 ADTT ≤ 100 -- 1.40
	Service I	1.00	1.00	1.00
Wood	Strength II	1.25	1.50	Unknown ADTT -- 1.80 ADTT ≥ 5000 -- 1.80 ADTT = 1000 -- 1.65 ADTT ≤ 100 -- 1.40

925.4 DYNAMIC LOAD ALLOWANCE (IM)

A. A dynamic load allowance of 33% shall be used for all non-buried bridges except for fatigue evaluation.

B. For fatigue evaluation a dynamic load allowance of 15% shall be used.

C. Dynamic load allowance shall only be applied to truck or tandem portion of HL-93 loading (dynamic load allowance shall not be provided to lane portion).

D. Dynamic load allowance needs not to be applied to wood components of a bridge.

E. Dynamic allowance may be ignored for slow moving (speed less than 10 mph) special or permit loads under controlled conditions.

F. For buried bridges, dynamic allowance (IM) shall be taken as:

$IM = 33\ (1.0 - 0.125\ DE) \geq 0\%$ .... [AASHTO 3.6.2.2-1]

Where:

DE = the minimum depth of cover above the structure (ft)

925.5 CONDITION FACTOR (φ_c)

A Condition Factor shall be applied to the calculated capacity of the structure, as follows:

Table 925.5-1: Condition Factors [MBE 6A.4.2.3]

Structural Condition of a member	NBI General Appraisal	Condition Factor φ_c
Good or Satisfactory	6 or higher	1.00
Fair	5	0.95
Poor	4 or lower	0.85

925.6 SYSTEM FACTOR (φ_S)

System factors are multiplied to the nominal resistance to reflect the level of redundancy of the complete superstructure [MBE 6A.4.2.4]. Bridges that are less redundant will have their factored member capacities reduced.

The following system factors may be used for Flexural and Axial Effects:

Table 925.6-1: System Factors [MBE 6A.4.2.4]

Superstructure Type	φ_S
Welded members in two-girder/truss/arch bridges	0.85
Riveted members in two-girder/truss/arch bridges	0.90
Multiple eyebar members in truss bridges	0.90
Three-girder bridges with girder spacing 6 ft.	0.85
Four-girder bridges with girder spacing ≤ 4 ft.	0.95
Floor beams with spacing > 12.0 ft. and non-continuous stringers	0.85
Redundant stringer subsystems between floor-beams	1.00
All other girder and slab bridges	1.00

925.7 RESISTANCE FACTOR (φ)

Resistance factor (φ) for the load rating has the same value as for a new design as given in AASHTO LRFD Specification. Also, $\varphi = 1.0$ for all non-strength limit states [MBE C6A.4.2.1]. See appropriate section in the LRFD Specification for recommended values for resistance factors [LRFD 5.5.4.2, 6.5.4.2, 8.5.2, 12.5.5]

Some of the commonly used Resistance Factors are given here:

Table 925.7-1: Resistance Factors

Type	φ
Tension controlled reinforced concrete section	**0.90**
Tension controlled prestressed concrete section	**1.00**
Shear and torsion in normal weight concrete	**0.90**
Flexure in steel	**1.00**
Shear in steel	**1.00**
Axial Compression in steel only	**0.90**
Axial Compression in composite	**0.90**
Shear connectors, steel	**0.85**
Web crippling, steel	**0.80**
For block shear	**0.80**
For shear rupture in connection element	**0.80**
For weld metal in partial penetration and fillet weld	**0.80**
Flexure in wood	**0.85**
Shear in wood	**0.75**
Wood connections	**0.65**
RC cast-in-place buried box structures in flexure	**0.90**
RC cast-in-place buried box structures in shear	**0.85**
RC precast buried box structures in flexure	**1.00**
RC precast buried box structures in shear	**0.90**
RC precast buried 3-sided structures in flexure	**0.95**
RC precast buried 3-sided structures in shear	**0.90**
Structural steel pipe, minimum wall area & buckling	**1.00**
Structural steel pipe, minimum longitudinal seam strength	**0.67**

925.8 EFFECT OF SKEW

Effect of skew on the distribution of live loads shall be considered according to AASHTO LRFD Specifications (LRFD 4.6.2.2.2 and 4.6.2.2.3).

926 LOAD RATING OF NEW BRIDGES

926.1 LOADS TO BE USED FOR LOAD RATING

All new and replacement bridges whose preliminary design is started **after October 1, 2010**, and requiring load rating, shall be load rated at inventory and operating levels by the AASHTO LRFR method to comply with FHWA requirements. The load to be used for inventory and operating rating based on LRFR method shall be AASHTO's HL-93 loading (truck & lane or tandem & lane), according to Figure 902.

All bridges shall also be load rated for four Ohio Legal Loads (2F1, 3F1, 4F1, and 5C1) at operating level using the same method of analysis as used for inventory and operating ratings above. The four Ohio legal loads (2F1, 3F1, 4F1 and 5C1) are given in Figure 903.

All trucks used for analysis shall have transverse spacing, between centerline of wheels or wheel groups, of 6 ft. [1.830 m].

Long span bridges shall use the special load configurations given in BDM Section 917.

The inventory and operating ratings for the AASHTO HL-93 loading shall be expressed in terms of rating factors, rounded off to the nearest second decimal point. The operating ratings for each of the Ohio Legal Loads shall also be expressed in terms of rating factors of respective legal load rounded off to the nearest second decimal point. The summary rating for all of the Ohio Legal Loads shall be the smallest rating factor of the four vehicles expressed as a percentage rounded off to the nearest 5 (125%, 100%, 65%, etc.).

The owner may also require load rating to be done for special loads in addition to those specified above. The owner shall provide full configurations of the special load, including axle weights and spacing, number of tires on each axle, tire gauges and overall dimensions of the load. All special loads to be analyzed by the LRFR method of analysis at the operating level as per BDM Section 916 unless specified otherwise by the owner.

926.2 LOAD RATING OF NEW BURIED BRIDGES

926.2.1 CAST-IN-PLACE CONCRETE BOX & FRAME STRUCTURES

A. Cast-in-place bridges shall be load rated by the designer of the bridge.

B. BRASS-Culvert program shall be used to load rate the structure. For the BRASS-Culvert Analysis, see BDM Section 923.

926.2.2 PRECAST CONCRETE BOXES

926.2.2.1 PRECAST CONCRETE BOXES OF SPAN GREATER THAN 12-FT

A. The load rating analysis will be performed by the OSE.

B. BRASS-Culvert program shall be used to load rate the structure. For the BRASS-Culvert Analysis, see BDM Section 923.

926.2.2.2 PRECAST BOXES OF SPAN EQUAL TO OR LESS THAN 12-FT

A. Manufacturer shall submit the actual information about the dimensions and reinforcing bars/cage to the OSE along with the shop drawings before the placement of structure.

B. The load rating analysis will be performed by the OSE.

926.2.3 PRECAST FRAMES, ARCHES, AND CONSPANS & BEBO TYPE STRUCTURES

A. The load rating analysis will be performed by the manufacturer.

B. Load rating report shall be submitted along with the shop drawings before the placement of the precast units.

C. Use the design software to load rate the bridge.

926.2.4 ANALYSIS OF CONCRETE BOX SECTIONS & FRAMES

Unless more accurate soil data exits, calculate the rating based on a lateral pressure as specified in AASHTO.

Apply live load surcharge according to AASHTO.

Effect of soil-structure interaction shall be taken into account according to AASHTO.

Assume hinged connections between the walls and the top and bottom slabs unless there is adequate reinforcing steel continuous between the slab and the walls at the joint. In that case continuity between the slab and the walls can be assumed.

926.3 LOAD RATING OF NON-BURIED STRUCTURES

926.3.1 GENERAL

All structures including flat slabs, arch structures, frames, box sections, etc., having a fill or pavement material of less than 2'-0" [600 mm] on top of the structures shall be load rated according to the provisions of this Section.

All main structural members of the superstructure affected by live load shall be analyzed.

926.3.2 HOW THE LOAD RATING SHALL BE DONE

The designer shall analyze and load rate all spans which are designed to carry vehicular traffic.

The load rating analysis shall be based on the final design plans. At the inventory level, the load rating shall be equal to or greater than the design loading.

All members shall have actual net section and current conditions incorporated into the member's analysis.

Bridge members designed as non-composite with the deck slab should be analyzed as non-composite.

All dead loads are to be calculated based on the actual field conditions. Future dead loads shall not be applied, unless directed otherwise.

Total thickness of the composite concrete slab shall be used in load rating for the calculations of section properties. Do not subtract for the monolithic wearing surface.

Live load distribution factors, as defined in the current AASHTO LRFD, shall be used.

926.3.3 WHEN THE BRIDGE LOAD RATING SHALL BE DONE

The load rating of new bridges shall be done as per following:

926.3.3.1 BRIDGES DESIGNED UNDER MAJOR OR MINOR PLAN DEVELOPMENT PROCESS

For bridges designed under the Major or Minor Plan Development Process (PDP), perform the load rating and include the load rating report in the Stage 2 Detail Design Submission. When design modifications that affect the previously submitted load rating analysis occur after Stage 2 and prior to contract sale, revise and resubmit the load rating report to the District Project Manager. The District Project Manager will forward the final load rating report to the District Bridge Engineer.

926.3.3.2 BRIDGES DESIGNED UNDER MINIMAL PLAN DEVELOPMENT PROCESS

For bridges designed under the Minimal Plan Development Process (PDP), perform the load rating and include the load rating report in the Stage 3 Detail Design Submission. When design modifications that affect the previously submitted load rating analysis occur after Stage 3 and prior to contract sale, revise and resubmit the load rating report to the District Project Manager. The District Project Manager will forward the final load rating report to the District Bridge Engineer.

926.3.3.3 BRIDGES DESIGNED UNDER DESIGN-BUILD PROCESS

Unless otherwise indicated in the project scope, include the load rating report for bridges designed as part of a Design Build project with the Stage 2 Detail Design Submission. When design modifications that affect the previously submitted load rating analysis occur after Stage 2, revise and resubmit the load rating report to the District Project Manager. The District Project Manager will forward the final load rating report to the District Bridge Engineer.

926.3.3.4 BRIDGES DESIGNED UNDER VALUE ENGINEERING CHANGE PROPOSAL

For bridges re-designed under a Value Engineering Change Proposal (VECP), perform a load rating of the altered bridge design and submit the load rating report to the District Construction Engineer (DCE) with the Final VECP submission. The DCE will supply this information to the District Bridge Engineer.

927 LOAD RATING OF EXISTING BRIDGES

927.1 APPLICABILITY OF AASHTO DESIGN SPECIFICATIONS

This Section is consistent with the current AASHTO LRFD Bridge Design Specifications and Standard Specifications for Highway Bridges (14th edition). Where this Section is silent, the current AASHTO LRFD Bridge Design Specifications or Standard Specifications for Highway Bridges shall govern for LRFR and LFR methods respectively.

927.2 LOADS TO BE USED FOR LOAD RATING

Existing bridges, starting preliminary design, as defined in BDM Section 905, **after October 1, 2010**, may be load rated at inventory and operating rating by either LFR or LRFR method with the prior approval of the bridge owner. When LFR method is used the load for inventory and operating rating shall be AASHTO HS20-44 [MS 18]. When LRFR method is used the load for inventory and operating rating shall be AASHTO HL-93.

All bridges shall also be load rated for four Ohio Legal Loads (2F1, 3F1, 4F1, and 5C1) at operating level using the same method of analysis as used for inventory and operating ratings above. The four Ohio legal loads (2F1, 3F1, 4F1 and 5C1) are given in Figure 903.

All legal loads used for analysis shall have transverse spacing, between centerline of wheels or wheel groups, of 6 ft. [1.830 m].

For long span bridges as defined in BDM Section 905, use the special load configurations given in BDM Section 917.

The inventory and operating ratings for the HL-93 or HS20-44 loading shall be expressed in terms of rating factors, rounded off to the nearest two decimal points. The operating ratings for each of the Ohio Legal Loads shall also be expressed in terms of rating factors of respective legal load, rounded off to the nearest two decimal points. The summary rating for all of the Ohio Legal Loads shall be the smallest rating factor of the four legal loads expressed as a percentage rounded off to the nearest 5 (i.e. multiplied by 100).

The owner may also require load rating to be done for special loads in addition to those specified here. The owner shall provide full configurations of the special load, including axle weights and spacing, number of tires on each axle, tire gauges, overall dimensions of the load and the desired method of load rating (LRFR or LFR). All special loads to be analyzed as per BDM Section 916, unless specified otherwise by the owner.

927.3 LOAD RATING OF BRIDGES TO BE REHABILITATED

927.3.1 HOW THE LOAD RATING SHALL BE DONE

The designer shall analyze and load rate all spans which are designed to carry vehicular traffic.

The load rating analysis shall be based on the final design plans. At the inventory level, the load rating shall be equal to or greater than the design loading.

All members shall have actual net section and current conditions incorporated into the member's analysis. Any known section losses, defects or damage to the existing structural members shall be considered in the rating analysis.

Bridge members designed as non-composite with the deck slab should be analyzed as non-composite.

Structures to be rehabilitated shall be analyzed using the original design plans, the actual field conditions, and all major changes in the final rehabilitation plans.

A complete review of all the available inspection information as well as a thorough site inspection of the existing bridge must be performed to establish the current conditions prior to proceeding with the analysis.

Future wearing surface dead loads shall not be applied, unless directed otherwise.

Total thickness of the composite concrete slab shall be used in load rating for the calculations of section properties. Do not subtract for the monolithic wearing surface.

Live load distribution factors, in accordance with the governing AASHTO specifications, shall be used.

For existing bridges, the rater should review the original design plans as the first source of information for material strengths and stresses. If the material strengths are not explicitly stated on the design plans, ODOT Construction and Material Specifications (CMS) applicable at the time of the bridge construction shall be reviewed. This may require investigations into old ASTM or AASHTO Material Specifications active at the time of construction.

Ultimate or yield strengths of materials shall be as specified on the original design plans, unless it is required in the scope of services to conduct specific tests to determine the material strengths.

Figures 906 and 907 provide general information about Allowable Stresses in bending and shear and material strengths based on the year of construction. Any material stresses and strengths specified on the design plans shall supersede the values given in Figures 906 and 907.

The rater is cautioned to pay extra attention to the design plans and the year of construction, when determining material strengths for structures built during transition years of Figures 906 and 907 (e.g., for member type SS, years 1964-68, or 1988-93, etc.), as materials may have been substituted.

927.3.2 WHEN THE BRIDGE LOAD RATING SHALL BE DONE

The load rating of bridges to be rehabilitated shall be done as per following:

927.3.2.1 BRIDGES DESIGNED UNDER MAJOR OR MINOR PLAN DEVELOPMENT PROCESS

For bridges designed under the Major or Minor Plan Development Process (PDP), perform the load rating and include the load rating report in the Stage 2 Detail Design Submission. When design modifications that affect the previously submitted load rating analysis occur after Stage 2 and prior to contract sale, revise and resubmit the load rating report to the District Project Manager. The District Project Manager will forward the final load rating report to the District Bridge Engineer.

927.3.2.2 BRIDGES DESIGNED UNDER MINIMAL PLAN DEVELOPMENT PROCESS

For bridges designed under the Minimal Plan Development Process (PDP), perform the load rating and include the load rating report in the Stage 3 Detail Design Submission. When design modifications that affect the previously submitted load rating analysis occur after Stage 3 and prior to contract sale, revise and resubmit the load rating report to the District Project Manager. The District Project Manager will forward the final load rating report to the District Bridge Engineer.

927.3.2.3 BRIDGES DESIGNED UNDER DESIGN-BUILD PROCESS

Unless otherwise indicated in the project scope, include the load rating report for bridges designed as part of a Design Build project with the Stage 2 Detail Design Submission. When design modifications that affect the previously submitted load rating analysis occur after Stage 2, revise and resubmit the load rating report to the District Project Manager. The District Project Manager will forward the final load rating report to the District Bridge Engineer.

927.3.2.4 BRIDGES DESIGNED UNDER VALUE ENGINEERING CHANGE PROPOSAL

For bridges re-designed under a Value Engineering Change Proposal (VECP), perform a load rating of the altered bridge design and submit the load rating report to the District Construction Engineer (DCE) with the Final VECP submission. The DCE will supply this information to the District Bridge Engineer.

927.3.3 LOAD RATING OF BURIED BRIDGES

927.3.3.1 CAST-IN-PLACE STRUCTURES

A. Cast-in-place bridges shall be load rated by the designer of the bridge.

B. BRASS-Culvert program shall be used to load rate the structure. For the BRASS-Culvert Analysis, also see BDM Section 923.

927.3.3.2 PRECAST BOXES OF SPAN GREATER THAN 12-FT.

A. The load rating analysis will be performed by the OSE.

B. BRASS-Culvert program shall be used to load rate the structure. For the BRASS-Culvert Analysis, see BDM Section 923.

927.3.3.3 PRECAST BOXES OF SPAN EQUAL TO OR LESS THAN 12-FT

The load rating analysis will be performed by the OSE.

927.3.3.4 PRECAST FRAMES, ARCHES, AND CONSPANS & BEBO TYPE STRUCTURES

A. The load rating analysis for any new or replacement precast sections will be performed by the manufacturer; otherwise the load rating analysis will be performed as per the scope of services.

B. Load rating report shall be submitted along with the shop drawings before the placement of the units.

C. Use the design software to load rate the bridge.

927.3.3.5 ANALYSIS OF CONCRETE BOX SECTIONS & FRAMES

Unless more accurate soil data exits, calculate the rating based on a lateral pressure as specified in AASHTO.

Apply live load surcharge according to AASHTO.

Effect of soil-structure interaction shall be taken into account according to AASHTO.

Assume hinged connections between the walls and the top and bottom slabs unless there is adequate reinforcing steel continuous between the slab and the walls at the joint. In that case continuity between the slab and the walls can be assumed.

927.3.4 LOAD RATING OF NON-BURIED STRUCTURES

All structures including flat slabs, arch structures, frames, box sections, etc., having a fill or pavement material of less than 2'-0" [600 mm] on top of the structures shall be load rated according to the provisions of BDM Sections 911 through 925 (as applicable).

927.4 LOAD RATING OF EXISTING BRIDGES WITH NO REPAIR PLANS

927.4.1 HOW THE LOAD RATING SHALL BE DONE

The rater shall analyze and load rate all spans which are designed to carry vehicular traffic.

Existing structures shall be analyzed using the information from the original design plans and the actual field conditions.

A complete review of all the available inspection information as well as a thorough site inspection of the existing bridge must be performed to establish the current conditions prior to proceeding with the analysis.

The bridges rated using design plans shall be noted as such in the load rating report.

Allowable stresses for the working stress and the ultimate or yield strengths of materials for Load Factor ratings shall be as specified on the original design plans, unless it is required in the scope of services to conduct specific tests to determine the material strengths.

For existing bridges, the rater should review the original design plans as the first source of information for material strengths and stresses. If the material strengths are not explicitly stated on the design plans, ODOT Construction and Material Specifications (CMS) applicable at the time of the bridge construction shall be reviewed. This may require investigations into old ASTM or AASHTO Material Specifications active at the time of construction.

Total thickness of the composite concrete slab shall be used in load rating for the calculations of section properties. Do not subtract for the monolithic wearing surface.

Figures 906 and 907 provide general information about ODOT Allowable Stresses in bending and shear and material strengths based on the year of construction.

The rater is cautioned to pay extra attention to the design plans and the year of construction, when determining material strengths for bridges built during transition years of Figures 906 and 907 (e.g., for member type SS, years 1964-68, or 1988-93, etc.), as materials may have been substituted.

Any material stresses and specifications specified on the design plans shall supersede the values given in Figures 906 and 907.

927.4.2 WHEN THE BRIDGE LOAD RATING SHALL BE DONE

The load rating of existing bridges shall be done as per the Scope of Services.

927.4.3 LOAD RATING OF EXISTING BURIED BRIDGES

A. The load rating analysis will be performed as per the Scope of Services.

B. Unless specified otherwise, structures shall be load rated for the Loads as per BDM Section 927.3.3.

927.4.4 LOAD RATING OF NON-BURIED STRUCTURES

All structures including flat slabs, arch structures, frames, box sections, etc., having a fill or pavement material of less than 2’-0” [600 mm] on top of the structures shall be load rated according to the provisions of BDM Sections 911 through 925 (as applicable).

928 LOAD RATING OF NON-ODOT BRIDGES

Provisions of BDM Section 900 may also be applied to load rating of Non-ODOT buried and non-buried bridges at the discretion of the respective bridge owners.

The load rating files and report of a Non-ODOT bridge shall be submitted to the respective bridge owner. The bridge owner shall keep the bridge load rating report in bridge file for future reference and use.

Based on the field conditions and the load rating calculations, if the rating engineer determines a bridge should be posted for reduced load capacity, the engineer must immediately forward the recommendation to the respective bridge owner. Applicable portions of Section 918, Bridge Posting for Reduced Load Limits may be followed.

It is the responsibility of the respective bridge owner (or designated consultant/rating engineer) to ensure that the load rating information is finally updated in the ODOT BMS.

929 REFERENCES

A. AASHTO, 1978, "Guide Specifications for Fracture Critical Non-Redundant Steel Bridge Members," and all subsequent Interims.

B. AASHTO, 1983, "Manual for Maintenance Inspection of Bridges."

C. AASHTO, 1989, "Guide Specifications for Strength Evaluation of Existing Steel and Concrete Bridges."

D. AASHTO, 1990, "Guide Specifications for Fatigue Evaluation of Existing Steel Bridges," and all subsequent Interims.

E. BRASS-Culvert software developed by the Wyoming Department of Transportation (PO Box 1708, Cheyenne, WY 82003).

F. Duncan, J.M., 1979, "Design Studies For Aluminum Structural Plate Box Culverts," Kaiser Aluminum and Chemical Sales, Inc.

G. NCSPA, "Load Rating & Structural Evaluation of In-Service Corrugated Steel Structures," & Design Data Sheet No. 19, National Corrugated Steel Pipe Association (NCSPA, 202-452-1700).

H. AASHTO, 2003, "Manual for Condition Evaluation and Load Resistance Factor Rating (LRFR) of Bridges," and all subsequent Interims.

I. AASHTO, 2008, "The Manual for Bridge Evaluation," and all subsequent Interims.

J. AASHTO, 2010, "AASHTO LRFD Bridge Design Specifications", 5th Edition.

K. AASHTO, 2002, "Standard Specifications for Highway Bridges", 14th Edition, and all subsequent interims.

AASHTO HS20-44 LOADING

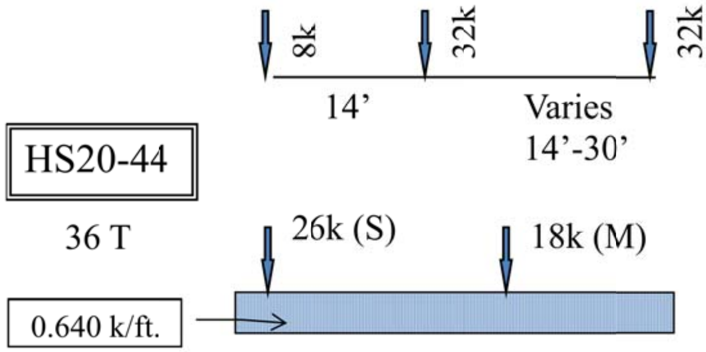


Figure 901

AASHTO HL93 LOADING

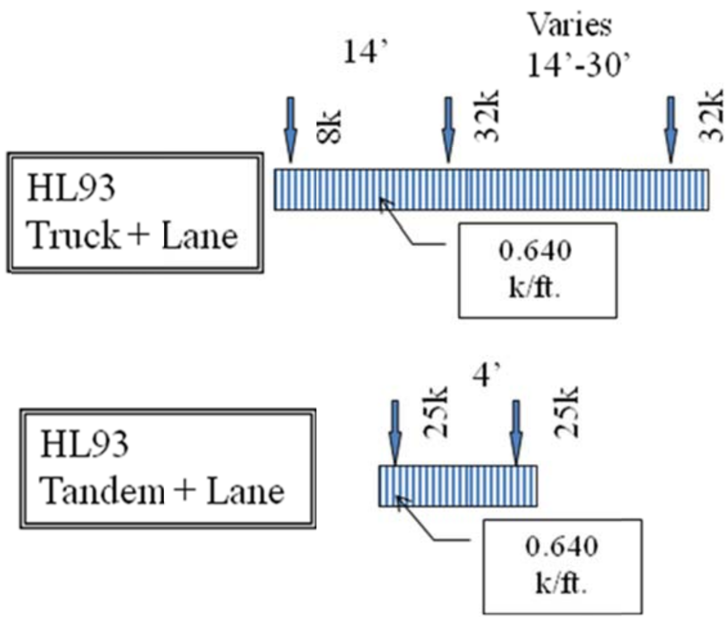


Figure 902

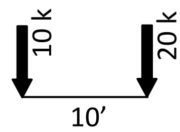
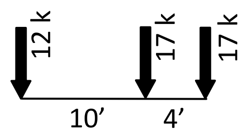
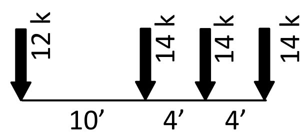
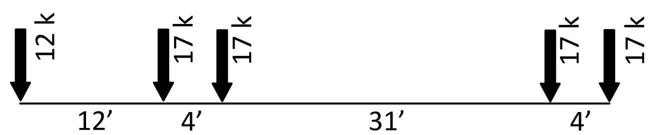
OHIO LEGAL LOADS		
Load Designation	**Load Configuration**	**Gross Weight**
2F1		15 Tons
3F1		23 Tons
4F1		27 Tons
5C1		40 Tons

Figure 903

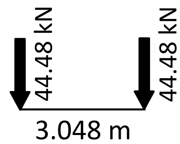
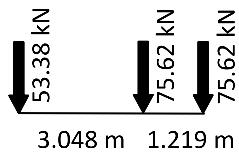
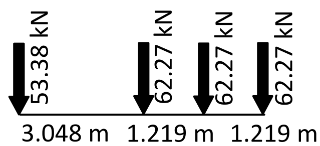
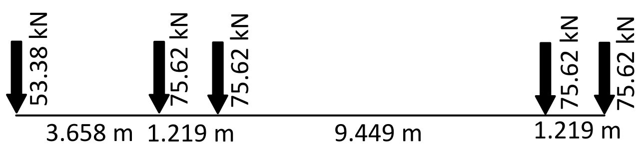
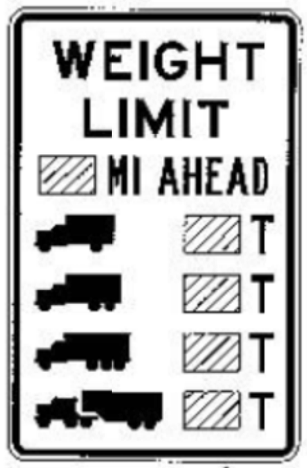
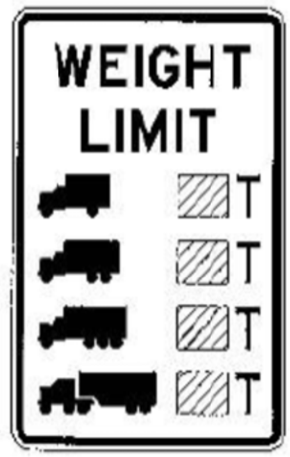
OHIO LEGAL LOADS (METRIC)		
Load Designation	**Load Configuration**	**Gross Weight**
2F1		13.608 Metric Tons
3F1		20.865 Metric Tons
4F1		24.494 Metric Tons
5C1		36.287 Metric Tons

Figure 904



Bridge Ahead Sign (R-79)



Bridge Weight Limit Sign (R-78)

Figure 905

CUSTOM ALLOWABLE STRESSES IN BENDING									
		Type of Rating							
Material of Construction	Year of Construction	Fy / Fc' (ksi)	Fy / Fc' (MPa)	Inventory (ksi)	Inventory (MPa)	Operating (ksi)	Operating (MPa)	Posting (ksi)	Posting (MPa)
Structural Steel (SS),(CSC)	< 1900	26.00	179	14.00	97	19.00	131	19.00	131
	1901 To 1930	30.00	207	16.00	110	22.00	152	22.00	152
	1931 To 1965	33.00	228	18.00	124	25.00	172	25.00	172
	1966 To 1990	36.00	248	20.00	138	27.00	186	27.00	186
	1991 To Date	50.00	345	27.00	186	37.50	259	37.50	259
Reinforcing Steel (RC)	< 1935	32.00	221	16.00	110	24.00	165	24.00	165
	1936 To 1950	36.00	248	18.00	124	27.00	186	27.00	186
	1951 To 1983	40.00	276	20.00	138	30.00	207	30.00	207
	1984 To Date	60.00	414	24.00	165	36.00	248	36.00	248
Prestress. Strands (Fs')	All Years	270.0	1862	-	-	-	-	-	-
Cast-in-Place Reinf. Conc. (Compression in Bending) (RC),(CSC)	< 1930	2.00	14	0.70	5	1.30	9	1.30	9
	1931 To 1950	3.00	21	1.00	7	1.50	10	1.50	10
	1951 To 1980	4.00	28	1.30	9	2.00	14	2.00	14
	1981 To Date	4.50	31	1.50	10	2.20	15	2.20	15
Prestressed Concrete (Fc') (PSC),(CPS)	All Years	5.50	38	-	-	-	-	-	-
Cast-in-Place Comp. Slab for Prestress. Conc. (Fc') (CPS)	All Years	4.00	28	-	-	-	-	-	-
Timber (fb) (TMB)	All Years			1.60	11	2.128	15	2.128	15
Cast-in-Place Slab for Composite Reinforced Concrete	< 1930	2.00	14	0.70	5	1.30	9	1.30	9
	1931 To 1950	3.00	21	1.00	7	1.50	10	1.50	10
	1951 To 1980	4.00	28	1.30	9	2.00	14	2.00	14
	1981 To Date	4.50	31	1.50	10	2.20	15	2.20	15

Figure 906

CUSTOM ALLOWABLE STRESSES IN SHEAR									
		Type of Rating							
Material of Construction	Year of Construction	Fy / Fc' (ksi)	Fy / Fc' (MPa)	Inventory (ksi)	Inventory (MPa)	Operating (ksi)	Operating (MPa)	Posting (ksi)	Posting (MPa)
Structural Steel (SS),(CSC)	< 1900	26.00	179	8.50	59	11.50	79	11.50	79
	1901 To 1930	30.00	207	9.50	66	13.50	93	13.50	93
	1931 To 1965	33.00	228	11.00	76	15.00	103	15.00	103
	1966 To 1990	36.00	248	12.00	83	16.00	110	16.00	110
	1991 To Date	50.00	345	17.00	117	22.50	155	22.50	155
Reinforcing Steel (RC)	< 1935	32.00	221	16.00	110	24.00	165	24.00	165
	1936 To 1950	36.00	248	18.00	124	27.00	186	27.00	186
	1951 To 1983	40.00	276	20.00	138	30.00	207	30.00	207
	1984 To Date	60.00	414	24.00	165	36.00	248	36.00	248
Cast-in-Place Reinforced Conc. (RC),(CSC)	< 1930	2.00	14	0.70	5	1.30	9	1.30	9
	1931 To 1950	3.00	21	1.00	7	1.50	10	1.50	10
	1951 To 1980	4.00	28	1.30	9	2.00	14	2.00	14
	1981 To Date	4.50	31	1.50	10	2.20	15	2.20	15
Prestressed Concrete (Fc') (PSC),(CPS)	All Years	5.50	38						
Timber (Horizontal Shear Stress) (fb) (TMB)	All Years	-	-	0.09	1	0.12	1	0.12	1

Figure 907

OHIO DEPARTMENT OF TRANSPORTATION
OFFICE OF STRUCTURAL ENGINEERING
BRIDGE LOAD RATING SUMMARY REPORT

SFN	BRIDGE NUMBER	DISTRICT
ORIGINAL CONSTRUCTION YEAR	REHABILITATION YEAR	OVERALL STRUCTURE LENGTH (FT)
FEATURE INTERSECTED:		
SPECIAL ASSUMPTIONS & COMMENTS:		
RATING & ANALYSIS OPTION: SELECT FROM LIST ON THE LEFT WHERE APPROPRIATE		
LOAD RATING PURPOSE:		
RATING SOFTWARE		
BASIS OF ANALYSIS:		
METHOD OF ANALYSIS:		
DESIGN LOADING (ORIGINAL):		
STRUCTURE RATING SUMMARY		
LOADING & RATING TYPE	RATING FACTOR - RF (Rounded to 2 decimal points)	RATING LOAD
INVENTORY CURRENT DESIGN		
OPERATING CURRENT DESIGN		
OHIO LEGAL - 2F1		OHIO LEGAL LOADS OVERALL MINIMUM RATING FACTOR
OHIO LEGAL - 3F1		
OHIO LEGAL - 4F1		OHIO LEGAL LOADS OVERALL CONTROLLING TRUCK
OHIO LEGAL - 5C1		
RATED BY, PE#	REVIEWED BY, PE#	REPORT DATE
AGENCY/FIRM	PHONE NUMBER	EMAIL

BR-100 (REV2010)

SFN: ________ BRIDGE NO.: ________

Figure 908

Plastic Moment Capacity of Aluminum Structural Plate with and without Stiffening Ribs					
Uncoated thickness in inches (cm)	Plastic Moment - Mp in kip.ft / ft (kN.m/m)				
	Structural plate only	Structural plate with single rib @ 2' 3" (68.58 cm)	Structural plate with single rib @ 1' 6" (45.72 cm)	Structural plate with single rib @ 9" (22.86 cm)	Structural plate with double rib @ 2' 3" (68.58 cm)
0.125 (0.3175)	2.6 (11.565)	6.2 (27.579)	7.5 (33.362)	10.3 (45.817)	9.0 (40.034)
0.150 (0.381)	3.2 (14.234)	7.2 (32.027)	8.6 (38.255)	12.0 (53.379)	10.8 (48.041)
0.175 (0.445)	3.7 (16.458)	7.9 (35.141)	9.4 (41.813)	12.9 (57.382)	12.6 (56.048)
0.200 (0.508)	4.2 (18.683)	8.6 (38.255)	10.3 (45.817)	14.0 (62.275)	13.9 (61.830)
0.225 (0.572)	4.8 (21.351)	9.2 (40.924)	11.1 (49.375)	14.9 (66.278)	15.2 (67.613)
0.250 (0.635)	5.3 (23.576)	9.8 (43.592)	12.1 (53.823)	16.0 (71.172)	15.8 (70.282)

Source: Duncan, J.M., 1979, "Design Studies For Aluminum Structural Plate Box Culverts," A report on the study conducted under the sponsorship of Kaiser Aluminum and Chemical Sales, Inc., page 28.

Figure 909